Section 5 - West Colorado River Basin
Water Supply and Use

5.1	Introduction	5-1
5.2	Background	5-1
5.3	Water Supply	5-3
5.4	Water Use	5-27
5.5	Interbasin Diversions	5-31
5.6	Water Budgets	5-31
5.7	Water Supply and Use Problems	5-31
5.8	Water Quality	5-36
5.9	Issues and Recommendations	5-36

Figures

5-1	Hydrologic Study Areas	5-2
5-2	Flow Diagram, Price River	5-4
5-3	Flow Diagram, San Rafael River	5-5
5-4	Flow Diagram, Dirty Devil River	5-6
5-5	Flow Diagram, Escalante River	5-7
5-6	Flow Diagram, Paria River	5-8
5-7	Stream Flow Gaging Stations	5-11
5-8	Annual Flows, Price River Near Heiner	5-12
5-9	Annual Flows, Huntington Creek Near Huntington	5-12
5-10	Annual Flows, Cottonwood Creek Near Orangeville	5-13
5-11	Annual Flows, Ferron Creek Near Ferron	5-13
5-12	Annual Flows, Muddy Creek Near Emery	5-14
5-13	Annual Flows, Fremont River Near Bicknell	5-14
5-14	Annual Flows, Pine Creek Near Escalante	5-15
5-15	Annual Flows, Escalante River Near Escalante	5-15
5-16	Annual Flows, East Fork Boulder Creek Near Boulder	5-16
5-17	Annual Flows, Paria River Near Cannonville	5-16
5-18	Monthly Streamflow Probabilities, Price River Near Heiner	5-18
5-19	Monthly Streamflow Probabilities, Huntington Creek Near Huntington	5-18
5-20	Monthly Streamflow Probabilities, Cottonwood Creek Near Orangeville	5-19
5-21	Monthly Streamflow Probabilities, Ferron Creek Near Ferron	5-19
5-22	Monthly Streamflow Probabilities, Muddy Creek Near Emery	5-20
5-23	Monthly Streamflow Probabilities, Fremont River Near Bicknell	5-20
5-24	Monthly Streamflow Probabilities, Pine Creek Near Escalante	5-21

5-25 Monthly Streamflow Probabilities, Escalante River Near Escalante 5-21
5-26 Monthly Streamflow Probabilities, East Fork Boulder Creek Near Boulder 5-22
5-27 Monthly Streamflow Probabilities, Paria River Near Cannonville 5-22
5-28 Lake Powell Water Budget, 1976-1995 5-26
5-29 Transbasin Diversions 5-33
5-30 Supply and Use Charts 5-35

Tables

5-1 Water Budget Yields (1961-1990) 5-3
5-2 Mean Monthly and Annual Stream Flow 5-9
5-3 Peak Flows 5-17
5-4 to 5-7 Flood Frequencies 5-23
5-8 to 5-11 Flood Frequencies 5-24
5-12 to 5-13 Flood Frequencies 5-25
5-14 GSENM Stream Gages 5-28
5-15 Current Water Supply Uses 5-29
5-16 Current Irrigation Water Use 5-29
5-17 Current Culinary Water Use 5-30
5-18 Current Secondary Water Use 5-30
5-19 West Colorado River Basin Transbasin Diversions 5-32
5-20 Summary Water Budget Analysis (1961-1990) 5-34
5-21 Water Rights Versus Yield 5-37

Section 5
West Colorado River Basin - Utah State Water Plan

Water Supply and Use

5.1 Introduction

This section discusses the present water supply and use of surface water as well as groundwater. Surface water supply comes primarily from the high mountain plateaus of the Price, San Rafael, Dirty Devil, Escalante and Paria hydrologic drainages.

Agriculture is the largest water user, with municipal and industrial use making up most of the remaining demand. Expanding development of industry and recreation areas will add to the water demand.

Huntington Creek

The basin water supply is provided from precipitation, mostly snow that collects in high mountain drainages.

5.2 Background

The water supply in the basin is influenced by storm paths and topography. Storms from the Pacific Ocean, and from the south and northwest, produce the largest amounts of precipitation, mostly in the form of snow. The base period for determining the surface water supply is water years 1941 through 1990. Some of the groundwater recharge and discharge data are discussed for different time periods. These will vary depending on the reports used. These reports were published by the U.S. Geological Survey, Division of Water Resources or Division of Water Rights.

Even though the Colorado River, its major tributary, the Green River, and Lake Powell form the eastern boundaries of the basin, very little water is actually diverted from these rivers or the lake for use in the basin. Hydrologically, the West Colorado River Basin is part of eight separate major drainage units, or hydrologic subareas (See Figure 5-1). Portions of the Lower Green, Lake Powell, San Juan and the Wahweap hydrologic subareas split at the basin boundary (the eastern Lake Powell shoreline). The Price, San Rafael, Dirty Devil, Escalante, and the Utah portion of the Paria, are all completely contained within the boundaries of the basin. Many normally dry drainages occasionally experience high-volume, short-duration flood flows produced by highly intense cloudburst storms. These can occur at any location within the basin and often cause considerable damage in the more populated areas.

The primary use of water in the West Colorado River Basin is for irrigation of crops. The power plants in Carbon and Emery counties account for the second biggest users of water within the basin.

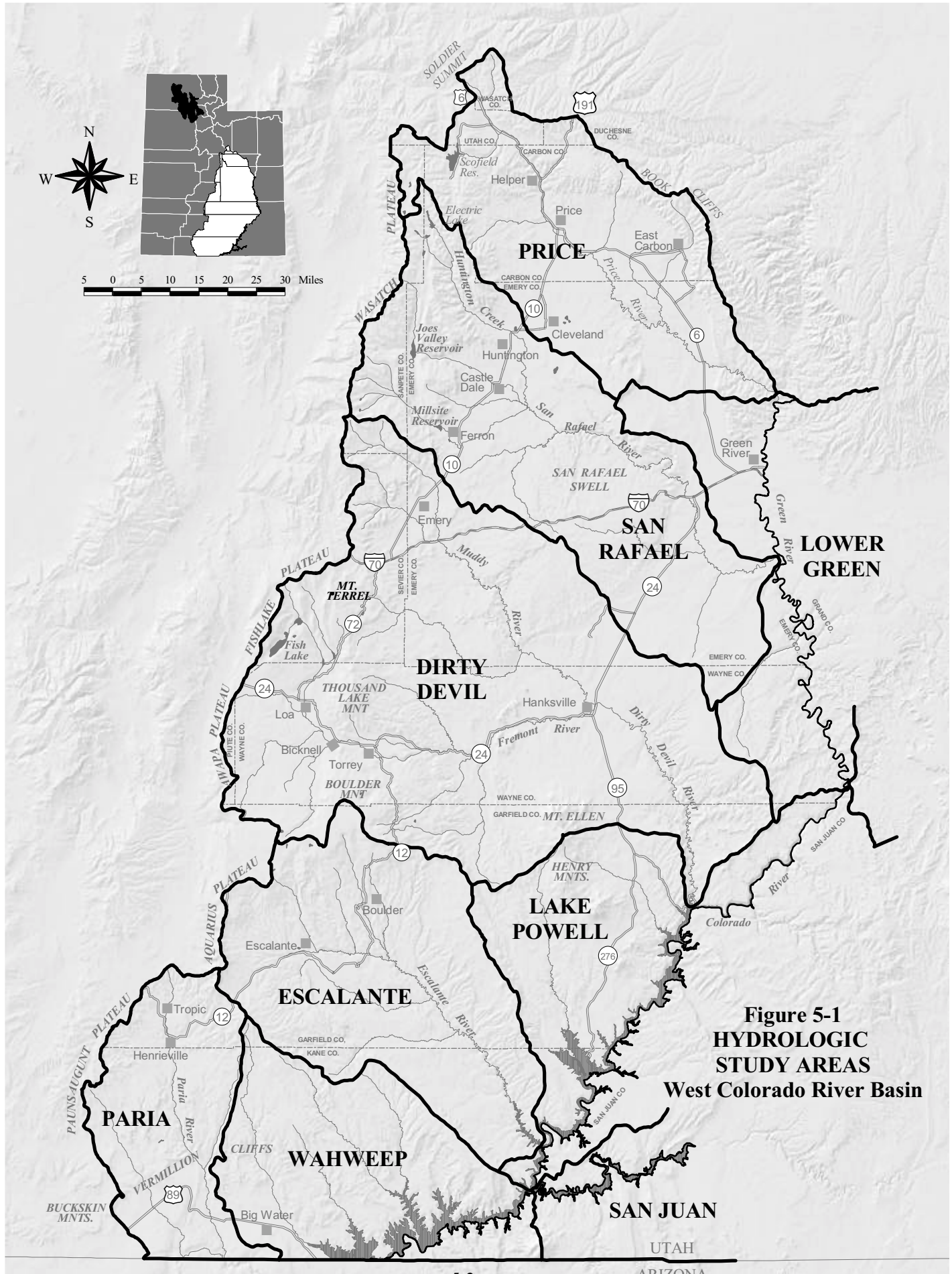


Figure 5-1
HYDROLOGIC STUDY AREAS
West Colorado River Basin

5.3 Water Supply

Most of the water used in the West Colorado River Basin is diverted from local streams and rivers. Some municipalities also use wells and springs for their water supplies.

5.3.1 Surface Water Supply

Although streams in the basin peak at different times depending on the watershed aspect, elevation and configuration, much of the surface water runoff comes from snowmelt during the months of April, May and June. What is not diverted for irrigation and municipal and industrial (M&I) uses in most of the basin eventually flows into the Colorado River System. This water and other Upper Colorado River basin states' (Wyoming, New Mexico and Colorado) non-diverted water is stored in Lake Powell.

Figures 5-2 through 5-6 show graphical representations of the average annual streamflows and diversions for the period 1941-1990 for five major river drainages that make up the West Colorado River Basin: Price, San Rafael, Dirty Devil, Escalante and Paria rivers. The volumes are derived or estimated from stream gages or other records by correlation, all of which are maintained and read by the U.S. Geological Survey. The yield for each subbasin is shown in Table 5-1. The annual and monthly mean flows for gaged streams are given in Table 5-2, and the locations are shown in Figure 5-7.

The annual flows at several locations in the basin are shown in Figures 5-8 through 5-17. The extreme maximum and minimum daily flows are given in Table 5-3.

The dampening effect of the major reservoirs is apparent as shown by gages just below those facilities. The only exceptions are during extremely wet years such as 1983-84. Variations in runoff patterns will be different in a watershed such as East Fork Boulder Creek which is steeper and shorter than one like the Fremont River. Vegetation and soils also influence runoff patterns. The flows at different probability levels of each of these 10 gages are shown on Figures 5-18 through 5-27, respectively. A probability level of 90 percent means nine times in 10 the flows will be greater than the values shown. A level of 50 percent means near average conditions. The numbers are based on a log normal frequency analysis.

During water budget compilation, river inflow into the area was mostly determined from gage records. The yield of a subbasin is defined as outflow minus inflow plus man-caused depletions. It is the water the basin would yield if mankind were not there.

Table 5-1
Water Budget Yields (1961-1990)

Subarea	Yield (Ac-Ft/Yr.)
Price	138,000
San Rafael	233,000
Dirty Devil	147,000
Escalante	86,000
Paria	21,000
Lower Green	5,000
Lake Powell	0
Wahweap	12,000
Total	630,000

Source: Utah Division of Water Resources

Most of the basin is prone to flash flooding from high-intensity, convective, summer thunderstorms. This type of flooding has more impact on tributaries than on the main stems of the five major river systems. Rapid snowmelt or rain on snow generally has more impact on main stem flows. The floods of 1983-84 were caused by a sudden increase in temperature melting a greater than normal snow pack with a moisture filled soil profile. As a result, flood flows in the main stems of the basin's five major rivers continued well into the summer. Flood frequencies for the ten gages used before are given in Tables 5-4 through 5-13.

5.3.2 Groundwater Supply [4]

Good quality groundwater is not a significant part of the total economically developable water supply of the West Colorado River Basin except in the Upper Fremont Valley in Wayne County. This supply is utilized through wells (pumped and flowing), springs, and subsurface water which supports vegetation, although most is pumped. Other areas in the basin have small amounts of groundwater which are utilized mostly by municipalities pumping wells or tapping springs. See Section 19 for more information on groundwater.

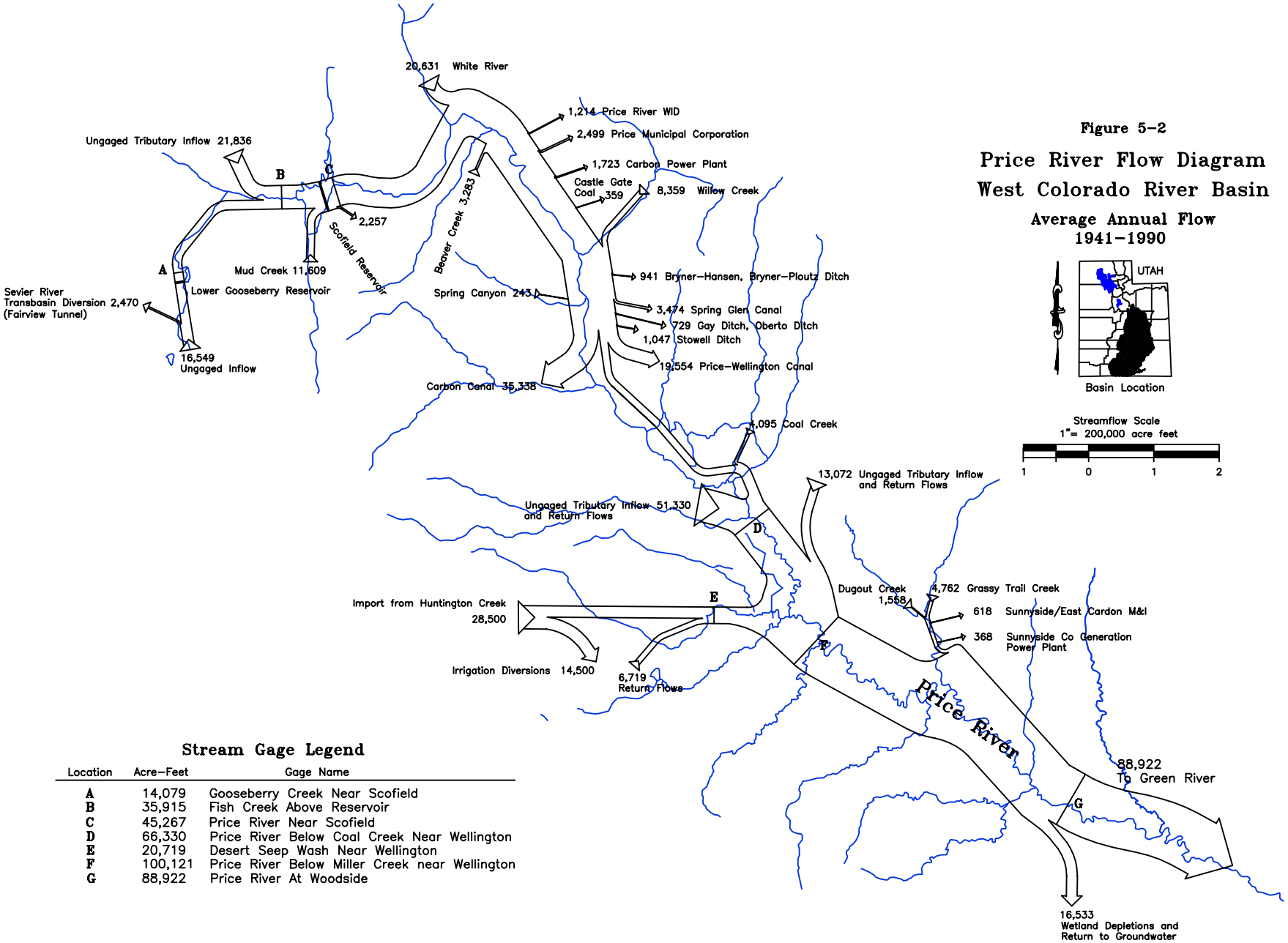


Figure 5-2

Price River Flow Diagram
West Colorado River Basin
Average Annual Flow 1941-1990

Stream Gage Legend

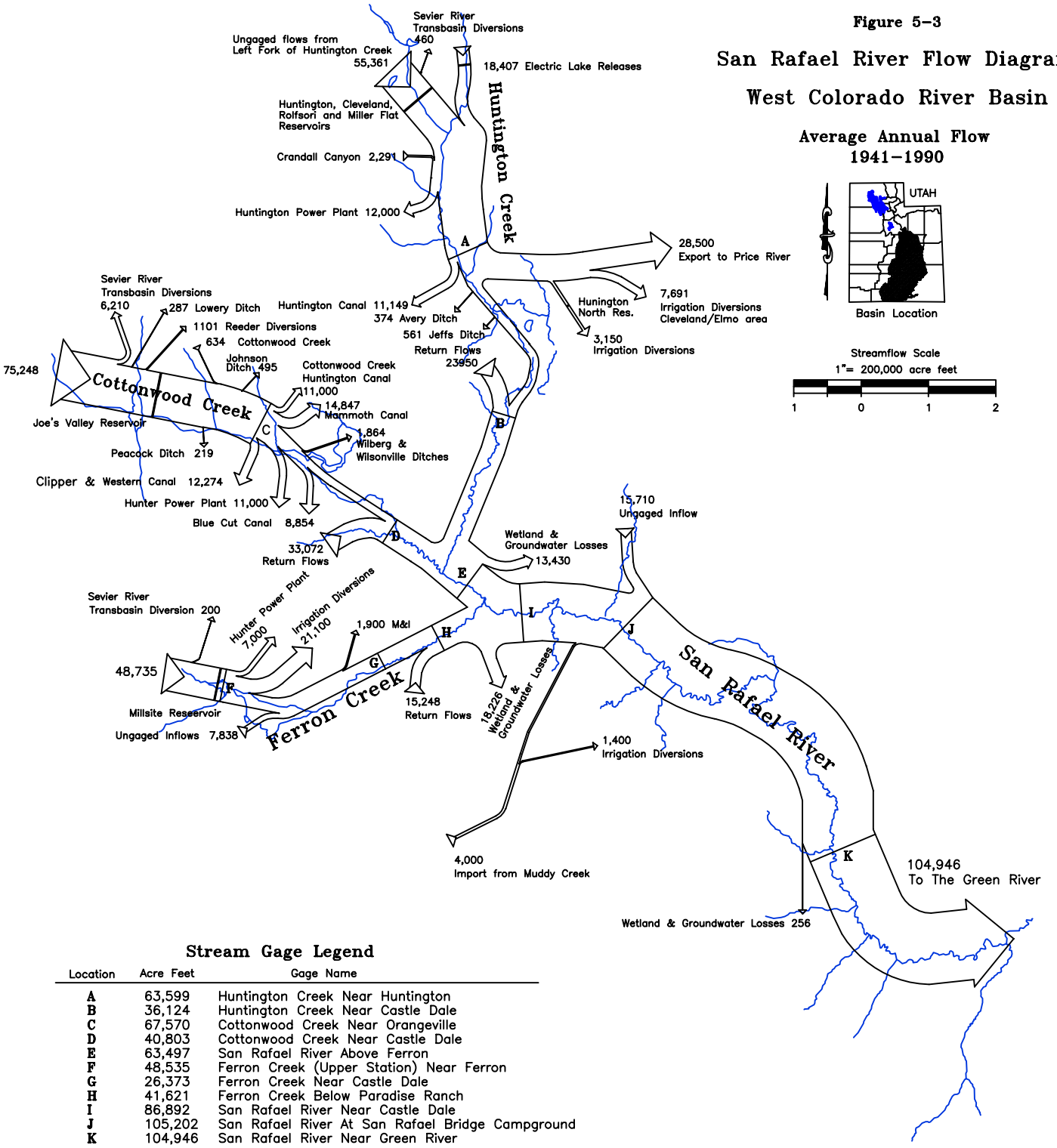
Location	Acre-Feet	Gage Name
A	14,079	Gooseberry Creek Near Scofield
B	35,915	Fish Creek Above Reservoir
C	45,267	Price River Near Scofield
D	66,330	Price River Below Coal Creek Near Wellington
E	20,719	Desert Seep Wash Near Wellington
F	100,121	Price River Below Miller Creek near Wellington
G	88,922	Price River At Woodside

Figure 5–3

San Rafael River Flow Diagram

West Colorado River Basin

Average Annual Flow
1941–1990



Stream Gage Legend

Location	Acre Feet	Gage Name
A	63,599	Huntington Creek Near Huntington
B	36,124	Huntington Creek Near Castle Dale
C	67,570	Cottonwood Creek Near Orangeville
D	40,803	Cottonwood Creek Near Castle Dale
E	63,497	San Rafael River Above Ferron
F	48,535	Ferron Creek (Upper Station) Near Ferron
G	26,373	Ferron Creek Near Castle Dale
H	41,621	Ferron Creek Below Paradise Ranch
I	86,892	San Rafael River Near Castle Dale
J	105,202	San Rafael River At San Rafael Bridge Campground
K	104,946	San Rafael River Near Green River

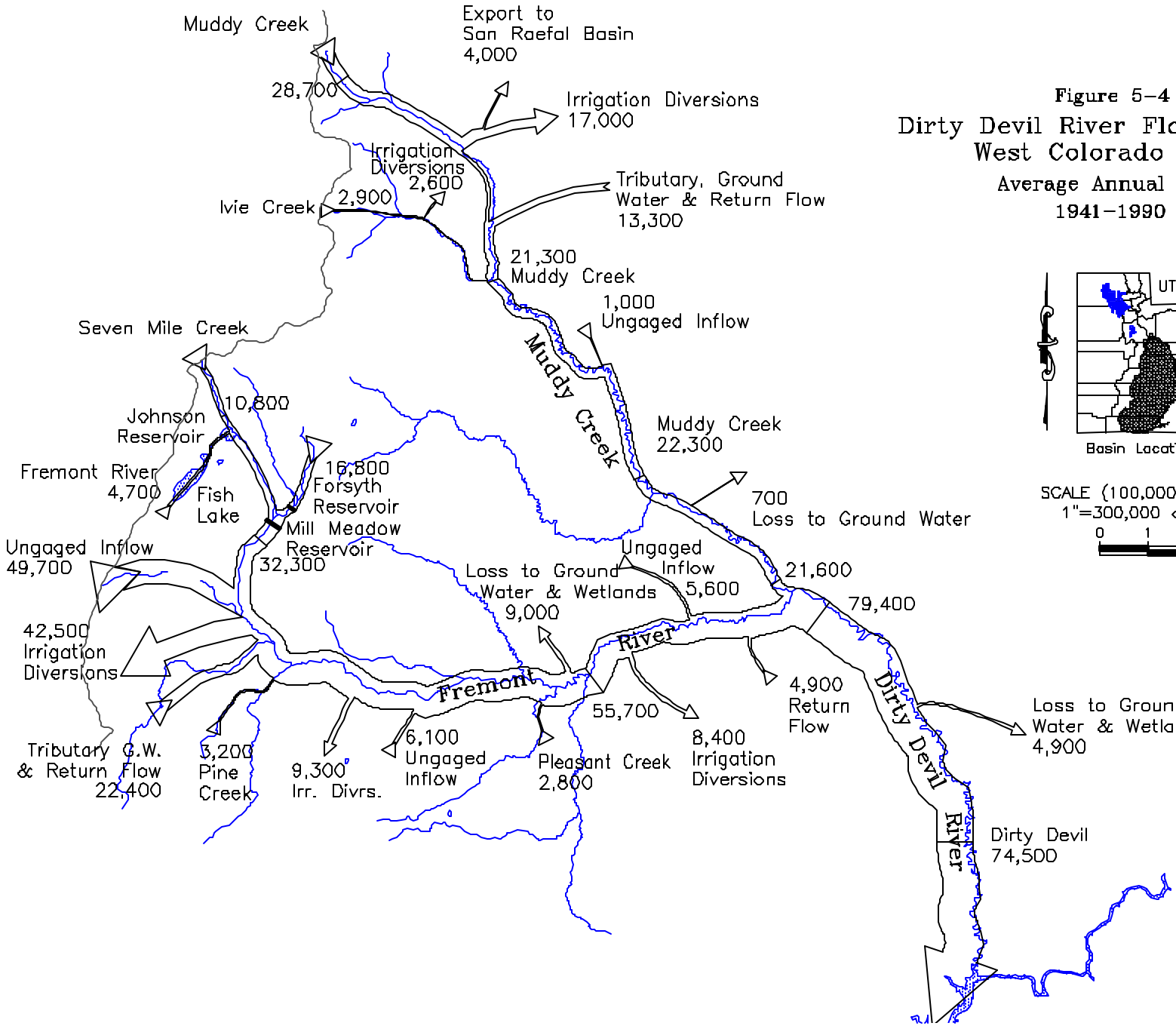


Figure 5-4

Dirty Devil River Flow Diagram
West Colorado Basin
Average Annual Flow
1941-1990

Figure 5–5

Escalante River Flow Diagram
West Colorado Basin

Average Annual Flow
1941–1990

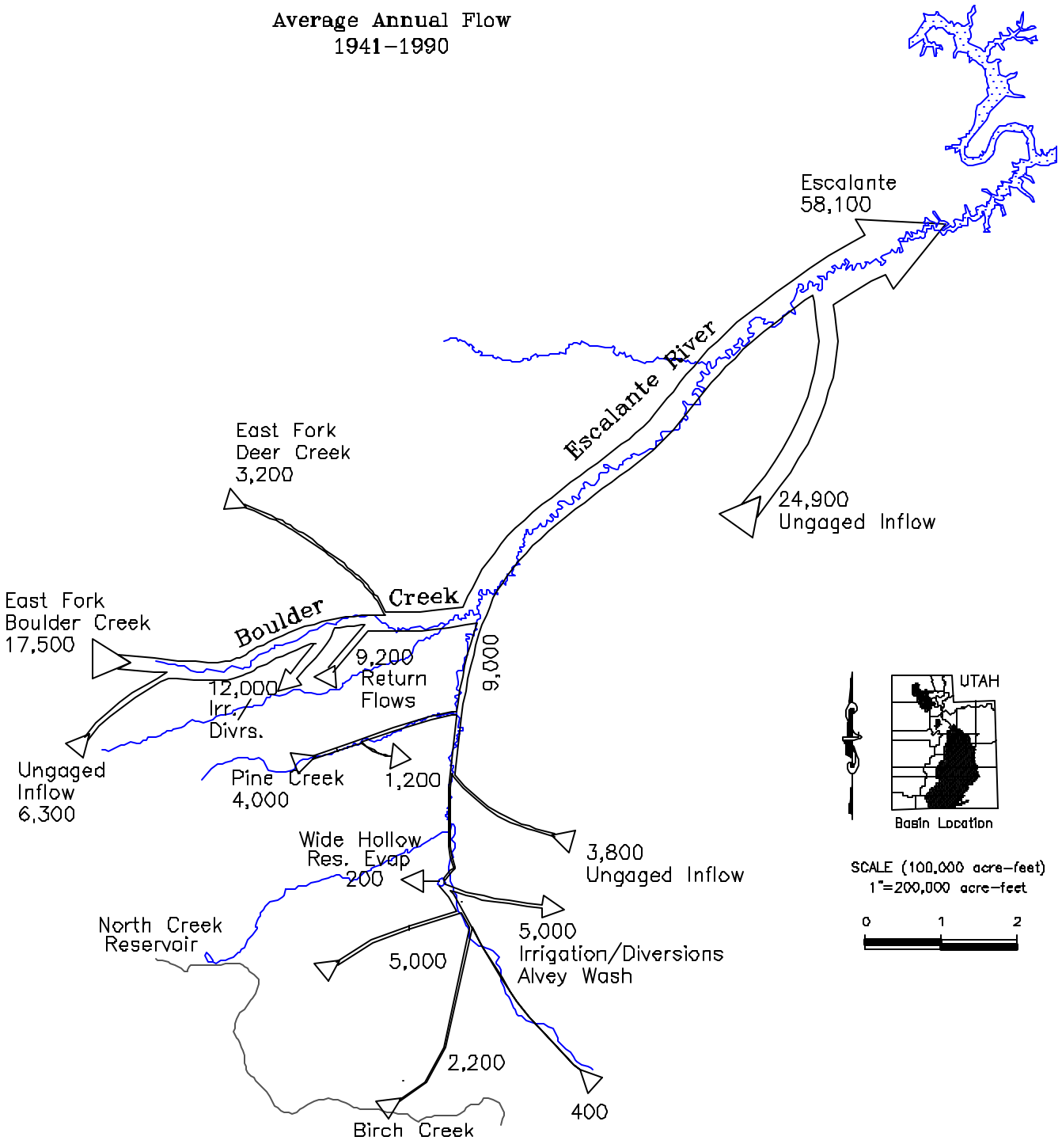


Figure 5-6

Paria River Flow Diagram
West Colorado Basin

Average Annual Flow
1941-1990

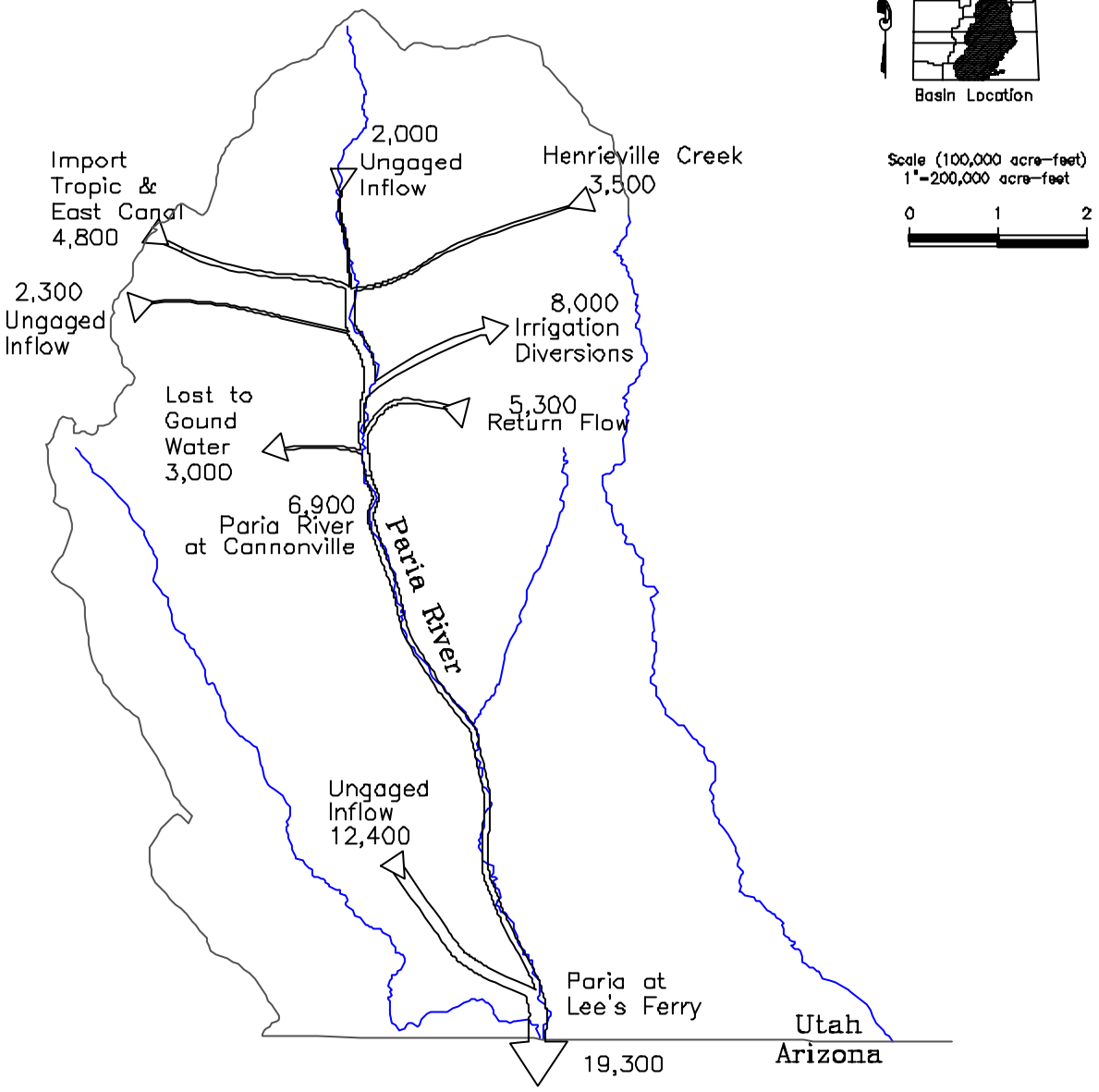


Table 5-2
Mean Monthly and Annual Stream Flow
(Acre-feet)

GAGE #	GAGE NAME	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
PRICE RIVER SYSTEM															
09309500	FAIRVIEW DITCH NEAR FAIRVIEW, UT	50-65	0	0	0	0	0	0	0	16	339	536	387	123	1,002
09310000	GOOSEBERRY CREEK NEAR SCOFIELD, UT	31-33	302	273	234	213	192	263	1,095	6,255	3,634	871	445	298	13,860
		40-98													
09310500	FISH CREEK ABOVE RESERVOIR, NEAR SCOFIELD, UT	31-33	700	667	599	544	519	818	3,648	16,383	8,425	1,864	901	652	35,453
		39-98													
09310550	PONTOWN CREEK NEAR SCOFIELD, UT	79-81	72	40	45	54	52	62	415	2,755	1,512	180	97	319	5,382
09310575	BOARDINGHOUSE CREEK AT MOUTH SOUTH OF SCOFIELD	83-86	73	64	57	51	47	53	96	733	823	233	121	99	2,531
09310600	ECCLES CANYON NEAR SCOFIELD, UT	80-87	110	91	91	90	85	107	208	1,002	1,038	277	167	144	3,410
09310700	MUD CREEK BLW WINTER QUARTERS CANYON AT SCOFIELD	78-87	433	368	338	326	320	479	1,070	3,833	3,512	920	519	460	12,567
		90-98													
09311500	PRICE RIVER NEAR SCOFIELD, UT	18-22	1,826	481	360	175	233	528	1,685	8,496	10,364	9,463	6,213	4,317	44,663
		25-32													
		39-70													
		79-82													
09311700	PRICE RIVER NEAR SOLDIER CUMMIT, UT	61-63	625	685	770	350	240	390	875	4,395	7,905	11,260	4.659	2,532	37,540
09312000	NORTH FORK WHITE RIVER NEAR SOLDIER SUMMIT, UT	42-47	46	49	34	42	45	173	1,932	2,132	495	79	39	23	4,537
09312500	WHITE RIVER NEAR SOLDIER SUMMIT, UT	38-67	233	209	183	166	171	408	3,253	6,294	1,784	605	309	223	14,051
09312600	WHITE R. BLW TABBYUNE CR. NR SOLDIER SUMMIT, UT	67-98	335	301	262	244	274	767	3,668	9,721	3,546	1,034	462	304	20,751
09312700	BEAVER CREEK NEAR SOLDIER SUMMIT, UT	61-90	64	54	50	49	52	99	342	1,452	826	194	72	49	3,304
09312800	WILLOW CREEK NEAR CASTLE GATE, UT	80-82	139	90	64	65	104	423	1,412	2,639	1,006	388	216	150	6,695
09312900	WILLOW CREEK AT CASTLE GATE, UT	80-82	191	121	62	86	103	210	1,468	3,575	1,272	411	218	235	7,949
09313000	PRICE RIVER NEAR HEINER, UT	34-71	2,553	1,043	764	625	755	2,395	9,339	20,936	14,984	11,746	7,862	4,999	78,412
		80-83													
		90-98													
09313040	SPRING CANYON BLW SOWBELLY GULCH AT HELPER, UT	79-82	26	21	20	19	15	15	15	18	12	15	19	20	215
09313500	PRICE RIVER NEAR HELPER, UT	09-34	3,181	2,028	1,828	1,854	1,900	5,330	14,547	36,319	20,038	7,702	5,845	4,602	98,885
09313965	COAL CREEK NEAR HELPER, UT	78-82	72	45	0	0	0	0	0	1,838	489	165	161	153	0
09313975	SOLDIER CREEK BELOW MINE NEAR WELLINGTON, UT	78-84	103	62	0	0	0	50	633	1,533	687	243	145	123	0
09313985	DUGOUT CREEK NEAR SUNNYSIDE, UT	80-82	18	7	0	0	0	0	0	607	159	52	22	52	0
09314000	PRICE RIVER BELOW COAL CREEK NEAR WELLINGTON, UT	50-58	1,956	1,675	1,450	1,381	1,675	2,624	8,742	17,149	8,378	3,180	4,267	2,157	54,634
09314250	PRICE RIVER BLW MILLER CREEK NEAR WELLINGTON, UT	72-86	5,136	3,387	2,116	2,062	3,154	7,548	14,734	26,826	21,025	6,030	4,374	4,596	105,565
09314280	DESERT SEEP WASH NEAR WELLINGTON, UT	72-86	2,504	1,684	869	687	933	1,991	1,873	2,317	2,198	2,205	1,966	2,223	21,812
09314340	GRASSY TRAIL CREEK AT SUNNYSIDE, UT	78-85	152	139	133	126	107	143	503	2,913	2,111	437	225	172	7,165
09314374	HORSE CANYON NEAR SUNNYSIDE, UT	78-82	19	20	17	22	16	15	28	41	27	25	23	20	270
09314500	PRICE RIVER AT WOODSIDE, UT	46-93	5,697	3,894	2,588	2,329	3,469	7,118	10,814	17,767	13,485	6,135	7,114	6.542	88,109
SAN RAFAEL RIVER SYSTEM															
09317000	BOULGER CREEK NEAR FAIRVIEW, UT	38-49	77	64	55	51	46	52	210	1,140	657	181	98	71	2,798
09317500	CANDLAND DITCH NEAR MOUNT PLEASANT, UT	50-58	0	0	0	0	0	0	6	43	109	48	10	3	310
09317919	CRANDALL CANYON AT MOUTH NEAR HUNTINGTON, UT	78-84	54	31	31	34	30	39	125	864	1,107	311	126	74	1,590
09317920	TIE FORK CANYON NEAR HUNTINGTON, UT	78-82	38	35	34	21	27	43	78	562	525	125	60	44	1,476
09317997	HUNTINGTON CREEK NER HUNTINGTON, UT	79-82	3,787	2,289	1,932	1,893	1,905	2,437	4,797	12,124	15,062	7,192	5,823	4,622	63,862
		86-90													
09318000	HUNTINGTON CREEK NEAR HUNTINGTON, UT	09-18	2,406	1,820	1,681	1,642	1,605	2,116	5,247	20,608	17,620	8,434	5,291	3,126	69,967
		19-74													
		78-81													
09318500	HUNTINGTON CREEK NEAR CASTLE DALE, UT	11-21	1,620	1,499	1,456	1,524	1,643	2,604	3,997	14,826	14,099	1,890	1,471	1,108	57,425
09321000	COAL FORK DITCH NEAR MOUNT PLEASANT, UT	49-59	3	0	0	0	587	0	10	74	133	47	10	5	0
		76-77													
09321500	TWIN CREEK TUNNEL NEAR MOUNT PLEASANT, UT	50-58	2	0	0	0	0	0	0	28	150	51	3	1	0
09322000	BLACK CANYON DITCH NEAR SPRING CITY, UT	50-58	4	0	0	0	0	0	3	41	192	53	3	0	0
09322500	CEDAR CREEK TUNNEL NEAR SPRING CITY, UT	49-58	7	6	6	6	6	6	7	75					
09323500	REEDER DITCH NEAR SPRING CITY, UT	49-58	9	5	0	0	0	0	7	63	106	59	24	12	0
09324000	SEELY CREEK NEAR ORANGEVILLE, UT	53-57	1,393	1,148	1,150	1,135	1,043	1,265	2,770	13,565	21,778	7,565	2,850	1,858	57,518
09324200	COTTONWOOD CR. AB STRAIGHT CANYON NR ORANGEVILLE,UT	78-82	36	30	20	16	18	33	42	146	247	85	47	41	537
09324500	COTTONWOOD CREEK NEAR ORANGEVILLE, UT	10-28	2,419	1,356	1,231	1,080	1,068	1,746	4,172	18,884	24,948	9,057	4,498	3,274	73,096
		33-72													
		75-87													

Table 5-2 (Continued)
Mean Monthly and Annual Stream Flow

GAGE #	GAGE NAME	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
09325000	COTTONWOOD CREEK NEAR CASTLE DALE, UT	47-58	676	775	841	895	1,058	929	1,440	11,204	17,746	2,347	1,203	581	39,667
09325100	SAN RAFAEL R. AB FERRON CR. NE CASTLE DALE, UT	65-71	2,592	2,216	2,559	2,034	2,125	2,964	3,135	10,615	24,672	8,364	5,042	3,217	69,533
09326500	FERRON CREEK (UPPER STATION) NEAR FERRON, UT	12-24	1,102	867	650	539	548	877	2,672	13,434	17,672	6,363	2,616	1,441	48,526
		48-98													
09327500	FERRON CREEK NEAR CASTLE DALE	12-15	563	579	523	521	525	697	1,607	6,959	9,848	1,851	668	505	25,765
		48-59													
09327550	FERRON CR. BL PARADISE RANCH NR CLAWSON, UT	76-86	1,103	742	547	435	574	588	954	6,015	24,449	5,195	1,670	1,120	43,393
09328000	SAN RAFAEL RIVER NEAR CASTLE DALE, UT	48-65	3,588	3,171	2,553	2,345	3,487	4,731	5,642	18,234	35,342	8,934	4,163	3,305	95,605
		72-87													
09328100	S. R. R..AT S. R. BR CAMPGROUND NEAR C. DALE, UT	75-86	5,539	3,987	2,944	2,537	4,095	5,618	7,249	16,168	48,984	14,851	6,078	5,711	123,761
09328500	SAN RAFAEL RIVER NEAR GREEN RIVER, UT	10-19	5,669	3,961	2,895	2,728	4,039	6,570	6,545	19,428	34,110	10,028	5,593	4,396	106,310
		46-98													
DIRTY DEVIL RIVER SYSTEM															
09330500	MUDDY CREEK NEAR EMERY, UT	11-14	1,116	710	1,740	1,871	1,721	1,303	1,940	6,312	7,389	4,306	2,512	1,551	32,469
		50-96													
09331950	CHRISTIANSEN WASH NEAR EMERY, UT	78-84	258	136	74	90	118	164	232	298	411	422	356	236	2,878
09332800	MUDDY CREEK AT MOUTH NEAR HANKSVILLE, UT	76-80	149	897	56	358	1,641	2,216	2,598	4,980	3,496	927	284	3,415	21,018
09334500	WHITE CANYON NEAR HANKSVILLE, UT	51-70	498	278	182	49	94	70	242	73	77	561	1,070	502	3,696
09329050	SEVEN MILE CREEK NEAR FISH LAKE, UT	65-98	573	498	459	420	365	430	846	2,923	2,271	844	672	580	10,886
09330210	PLEASANT CREEK NEAR CAINVILLE, UT	69-73	301	185	202	149	123	139	148	426	226	183	295	254	2,288
09331500	IVIE CREEK ABOVE DIVERSIONS NEAR EMERY, UT	51-61	138	139	128	114	129	192	314	606	370	272	278	148	2,829
09332100	MUDDY CREEK BELOW I-70 NEAR EMERY, UT	73-86	1,126	803	750	756	923	1,306	1,996	5,711	5,665	2,291	996	739	23,062
09333000	DIRTY DEVIL RIVER NEAR HANKSVILLE, UT	46-48	5,775	7,160	5,477	6,027	9,873	10,240	10,647	4,613	3,287	1,030	13,795	3,545	82,950
09329500	FREMONT RIVER NEAR FREMONT, UT	49-58	2,361	389	361	367	355	562	1,141	5,453	6,547	5,928	4,364	2,437	29,822
09330000	FREMONT RIVER NEAR BICKNELL, UT	9-14	5,355	5,483	5,675	5,774	5,694	6,704	7,605	5,525	4,192	4.257	4,698	4,777	64,556
		38-59													
		77-95													
09331900	QUITCHUPAH CREEK NEAR EMERY, UT	78-81	158	258	267	335	370	581	636	1,025	657	316	159	975	6,102
09332700	MUDDY CREEK AT DELTA MINE NEAR HANKSVILLE	76-86	1,078	743	524	598	1,196	1,358	2,077	5,655	5,582	2,226	1,150	1,478	23,664
09330230	FREMONT RIVER NEAR CAINVILLE, UT	67-95	6,150	7,721	5,468	9,078	7,598	6,362	5,620	3,854	2,586	2,847	3,572	3,659	54,421
09331850	CONVULSION CANYON NEAR EMERY, UT	81-85	48	78	0	0	0	0	0	76	78	52	58	43	0
09332500	MUDDY CREEK BELOW IVIE CREEK NEAR EMERY, UT	50-61	347	297	287	268	419	744	1,378	3,155	2,301	489	845	559	11,131
09333500	D. DEV. R.. AB POISON SPR. WASH NR HANKSVILLE	48-95	6,092	7,550	5,926	6,011	7.625	8,502	6,393	5,160	4,194	3,494	5,944	5,170	72,027
09329000	FREMONT RIVER BELOW FISH LAKE, UT	39-45	87	30	33	24	22	24	21	21	1,688	1,925	797	178	5,083
09330410	BULL CREEK NEAR HANKSVILLE, UT	83-91	45	31	22	17	16	20	68	368	285	122	74	71	1,175
09334000	NORTH WASH NEAR HANKSVILLE (HITE), UT	50-70	67	90	30	31	28	22	15	40	58	105	233	133	868
09329900	PINE CREEK NEAR BICKNELL, UT	65-80	233	219	182	176	155	195	279	629	160	189	239	233	2,888
ESCALANTE RIVER SYSTEM															
09335500	NORTH CREEK NEAR ESCALANTE, UT	50-55	377	247	166	159	238	382	538	1,179	942	524	421	335	5,538
09336000	BIRCH CREEK NEAR ESCALANTE, UT	50-51	54	19	0	6	15	12	53	55	63	35	61	22	391
09336500	BIRCH CREEK AT MOUTH NEAR ESCALANTE, UT	52-55	133	124	82	105	160	213	137	302	237	265	191	169	2,366
09337000	PINE CREEK NEAR ESCALANTE, UT	50-56	177	160	131	127	117	158	402	1.053	430	340	294	213	3,611
		57-96													
09337500	ESCALANTE RIVER NEAR ESCALANTE, UT	12-13	499	411	464	520	587	791	888	1,455	1,133	433	553	997	8,865
		43-56													
		72-96													
09338000	EAST FORK BOULDER CREEK NEAR BOULDER, UT	50-56	1,261	1,204	1,162	1,146	1,035	1,136	1,232	3,079	2,142	1,290	1,301	1,226	17,192
		57-72													
09338500	EAST FORK DEER CREEK NEAR BOULDER, UT	50-55	83	63	53	57	49	87	127	119	89	91	94	78	987
09339000	BOULDER CREEK NEAR BOULDER, UT	50-55	797	1,425	1,911	2,021	1,873	2,013	1,255	2,030	1,000	701	824	734	16,681
09339500	ESCALANTE RIVER AT MOUTH NEAR ESCALANTE, UT	50-55	5,080	4,548	5,311	5,798	5,353	5,815	4,099	4,598	2,272	4,070	9,247	3,602	61,628
PARIA RIVER SYSTEM															
09381500	PARIA RIVER NEAR CANNONVILLE, UT	51-55	374	480	600	509	640	1,007	434	137	53	693	1,299	321	7,021
09381000	HENRIEVILLE CREEK NEAR HENRIEVILLE, UT	50-55	244	267	265	248	338	423	389	284	197	315	346	311	3,751
09382000	PARIA RIVER AT LEES FERRY, AZ	24-94	1,839	1,414	1,296	1,377	2,172	2,440	1,280	662	428	1,545	3,455	3,140	21,028
COLORADO RIVER SYSTEM															
09335000	COLORADO RIVER AT HITE, UT	47-58	349,273	367,727	309,545	297,909	305,455	458,455	905,545	2,165,091	2,730,364	1,097,727	522,192	312,442	9,783,455
09380000	COLORADO RIVER AT LEES FERRY, AZ	12-97	581,612	543,642	525,170	532,178	500,036	608,118	1,003,773	1,929,492	2,193,388	1,165,846	780,647	632,071	10,975,972
09379504	LAKE POWELL INFLOW (GREEN + COLORADO0	14-18	421,782	388,866	343,733	327,320	338,947	496,275	947,933	2,179,689	2,475,011	1,034,556	484,861	373,185	9,764,819
		23-85													
09315000	GREEN RIVER AT GREEN RIVER, UT	95-00	184,946	168,298	140,614	138,563	154,406	276,152	435,840	970,662	1,148,936	503,475	230,683	167,810	4,522,635

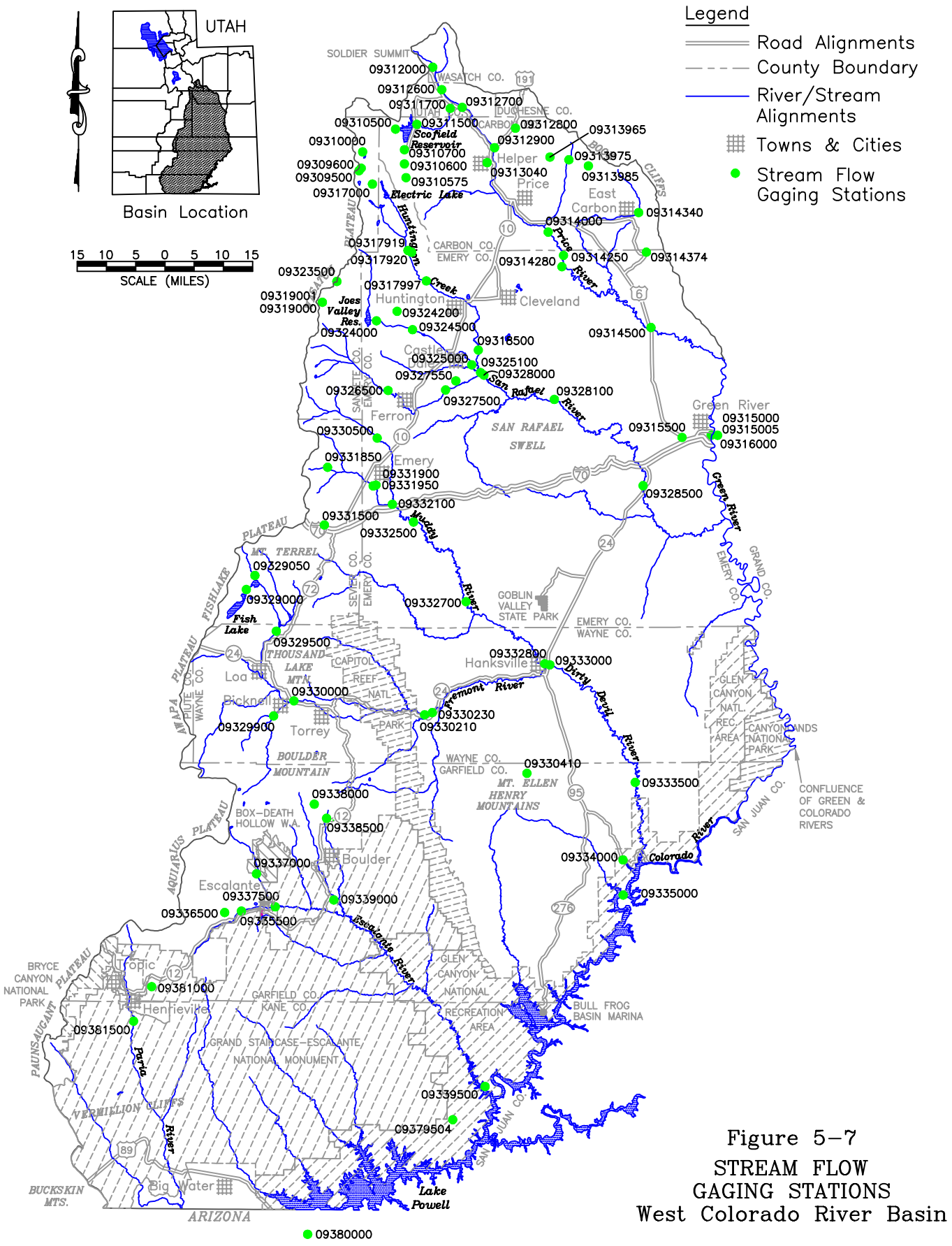


Figure 5–7
STREAM FLOW GAGING STATIONS
West Colorado River Basin

FIGURE 5-8

Annual Flows

Price River near Heiner (Helper)

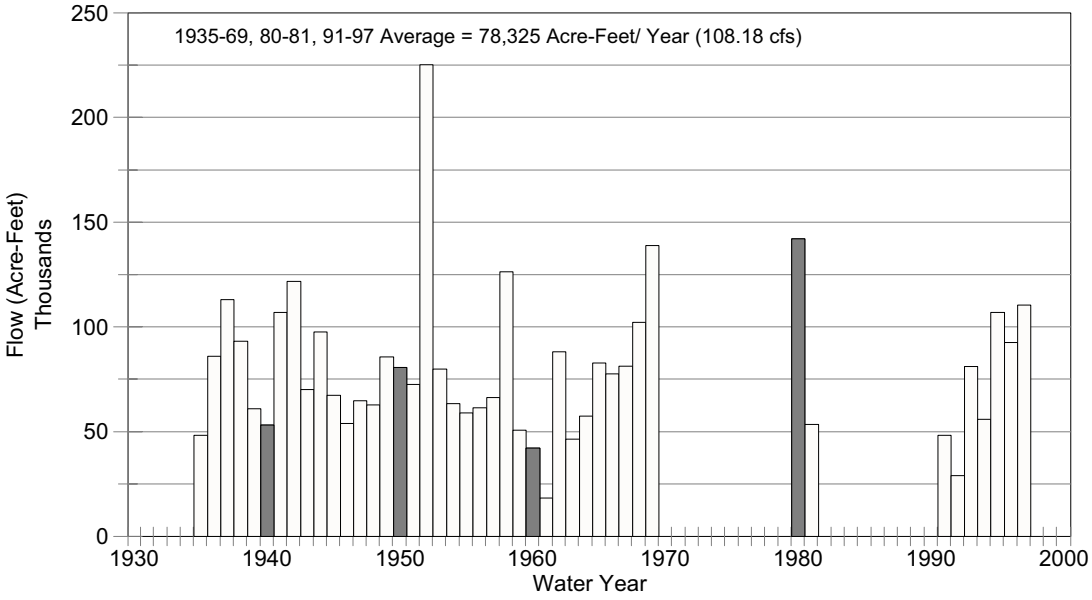


FIGURE 5-9

Annual Flows

Huntington Creek near Huntington

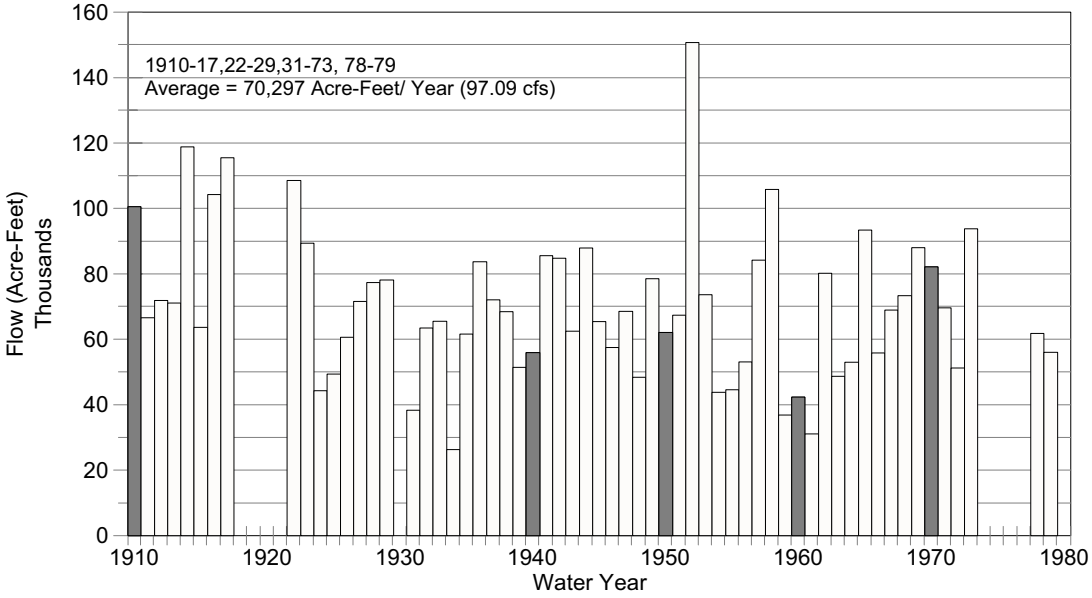


FIGURE 5-10
Annual Flows
Cottonwood Creek near Orangeville

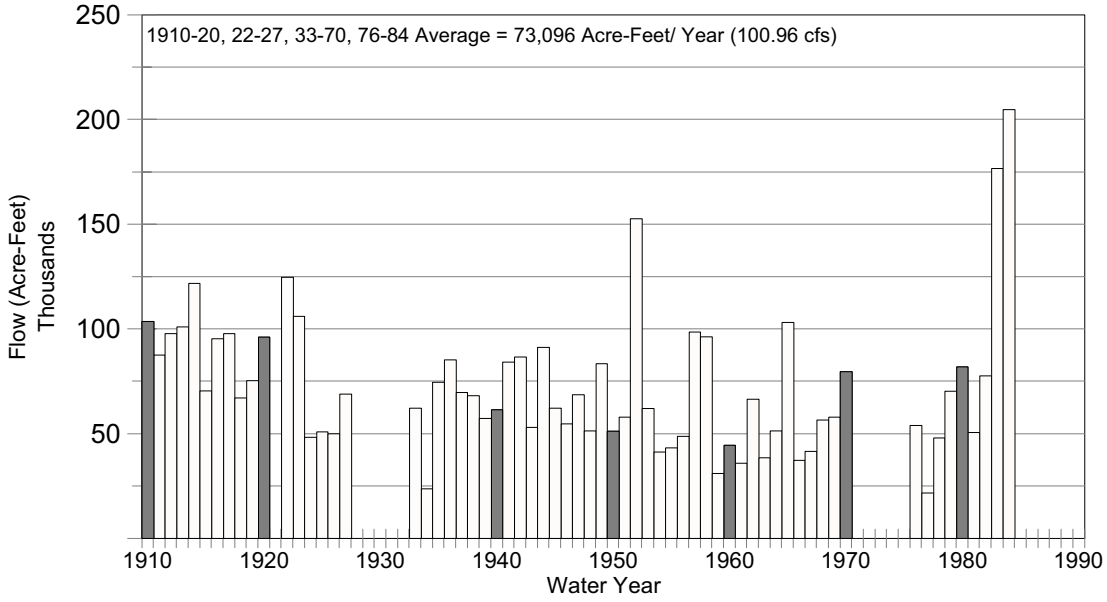


FIGURE 5-11
Annual Flows
Ferron Creek (Upper Station) nr Ferron

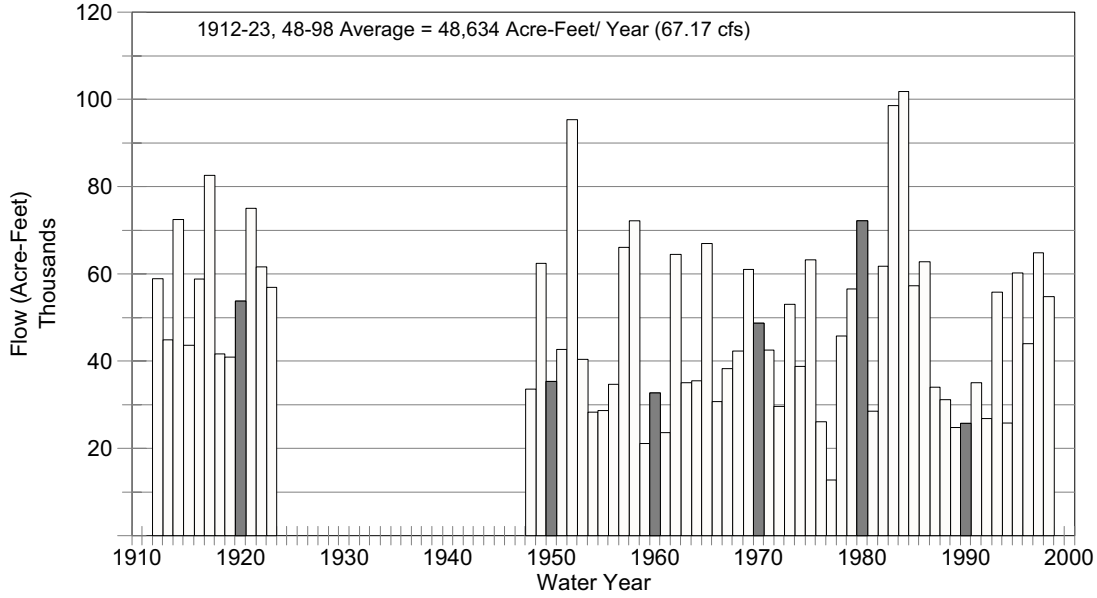


FIGURE 5-12
Annual Flows
Muddy Creek near Emery

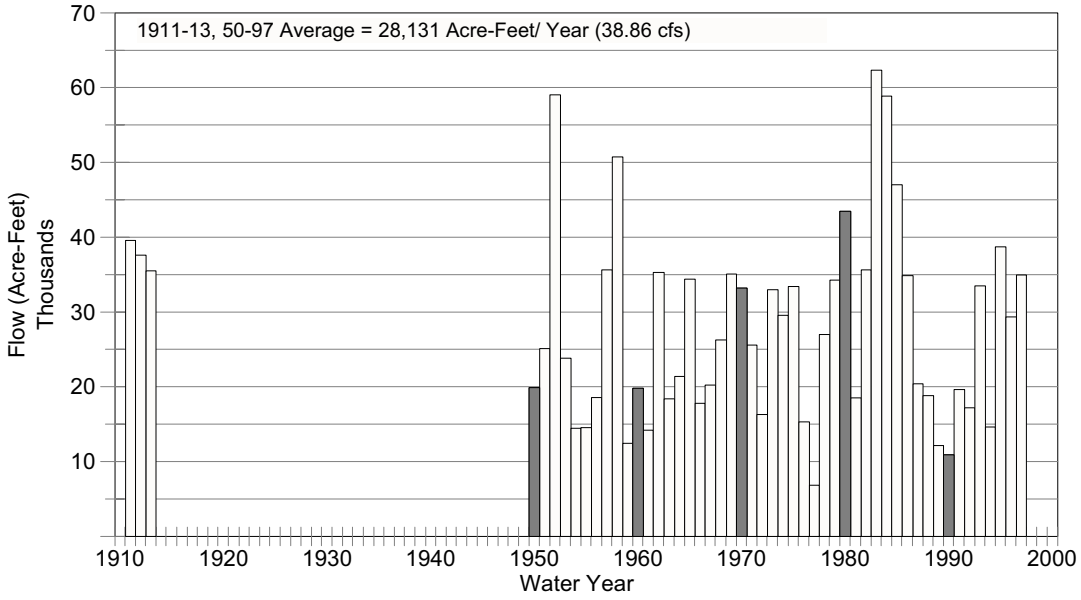


FIGURE 5-13
Annual Flows
Fremont River near Bicknell

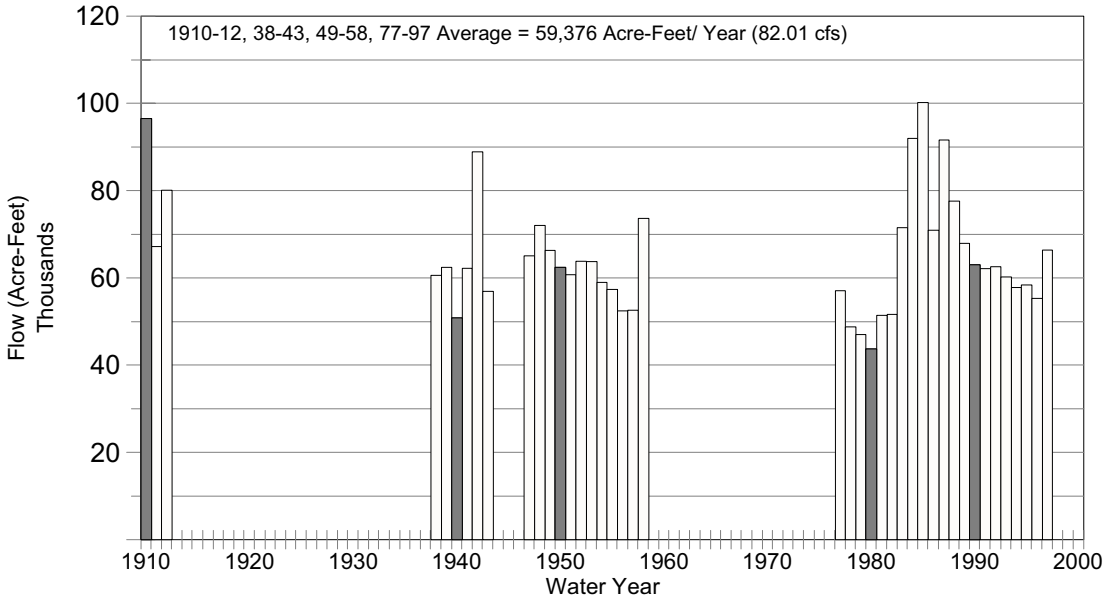


FIGURE 5-14
Annual Flows
Pine Creek near Escalante

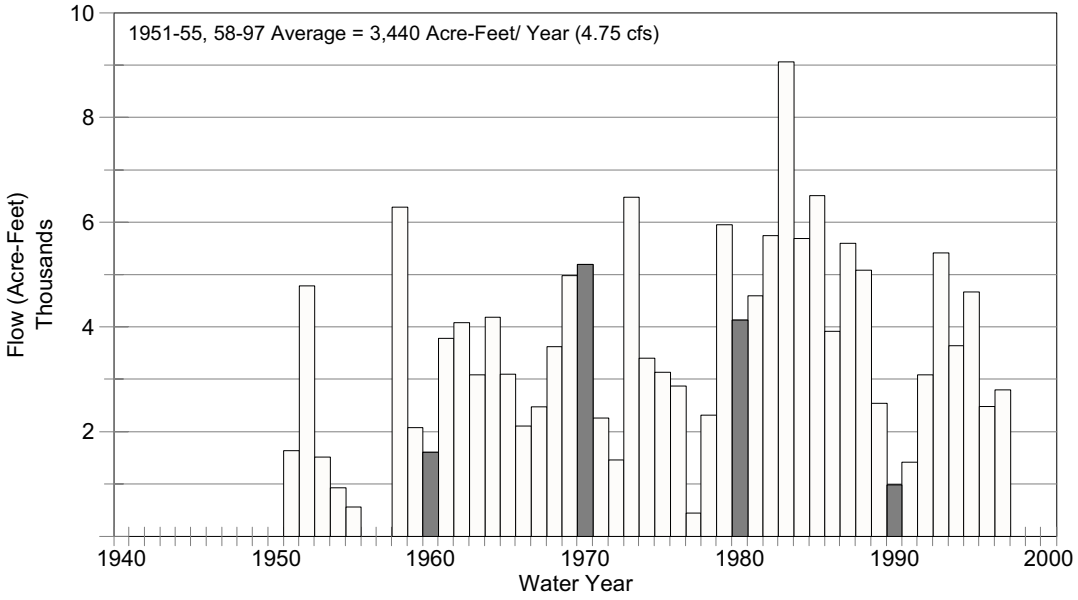


FIGURE 5-15
Annual Flows
Escalante River near Escalante

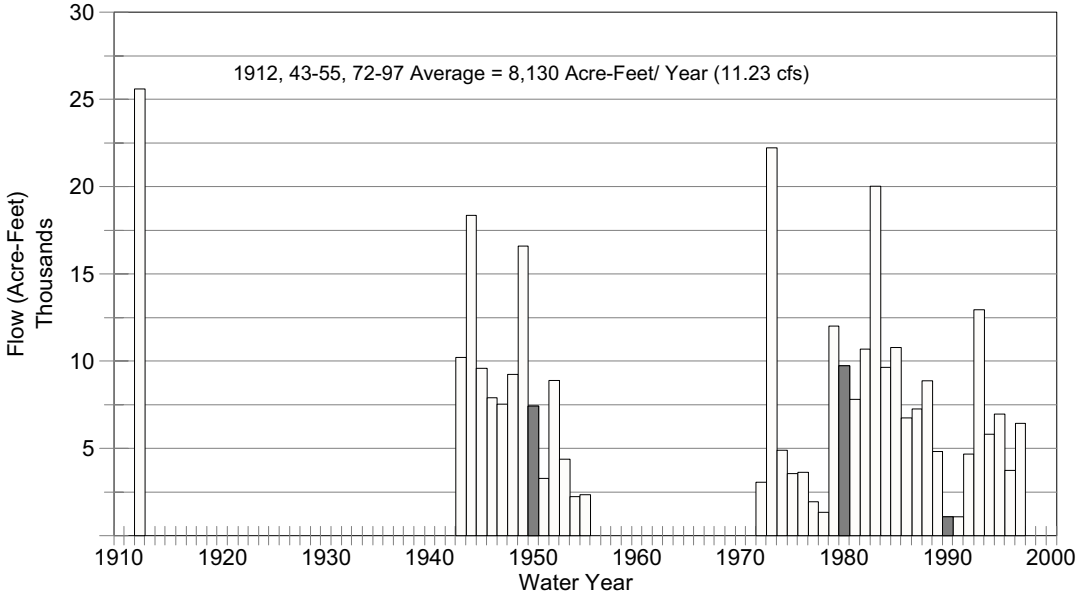


FIGURE 5-16
Annual Flows
East Fork Boulder Creek near Boulder

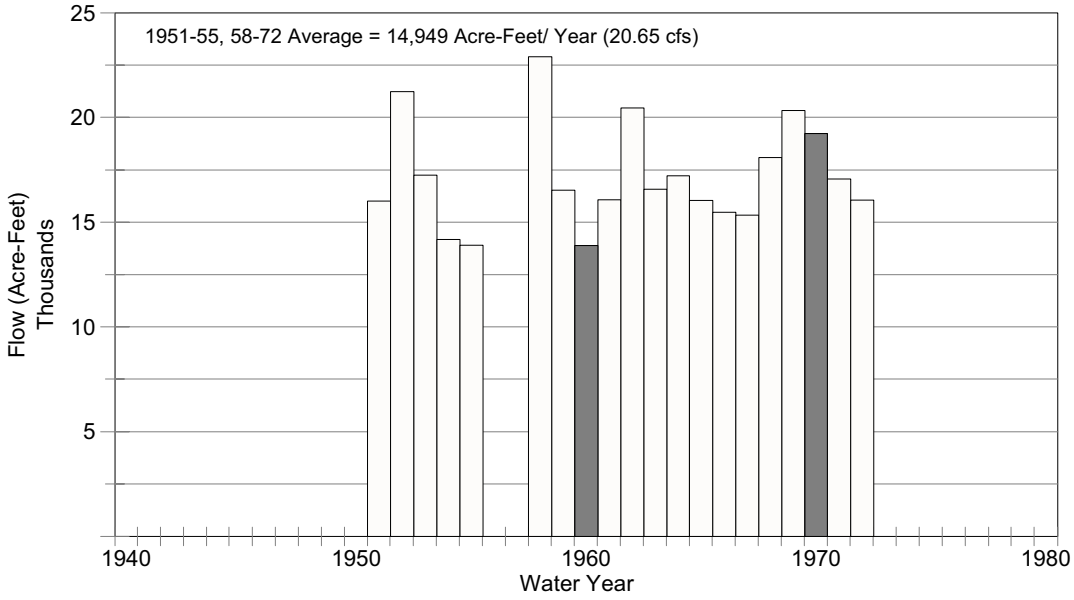


FIGURE 5-17
Annual Flows
Paria River near Cannonville

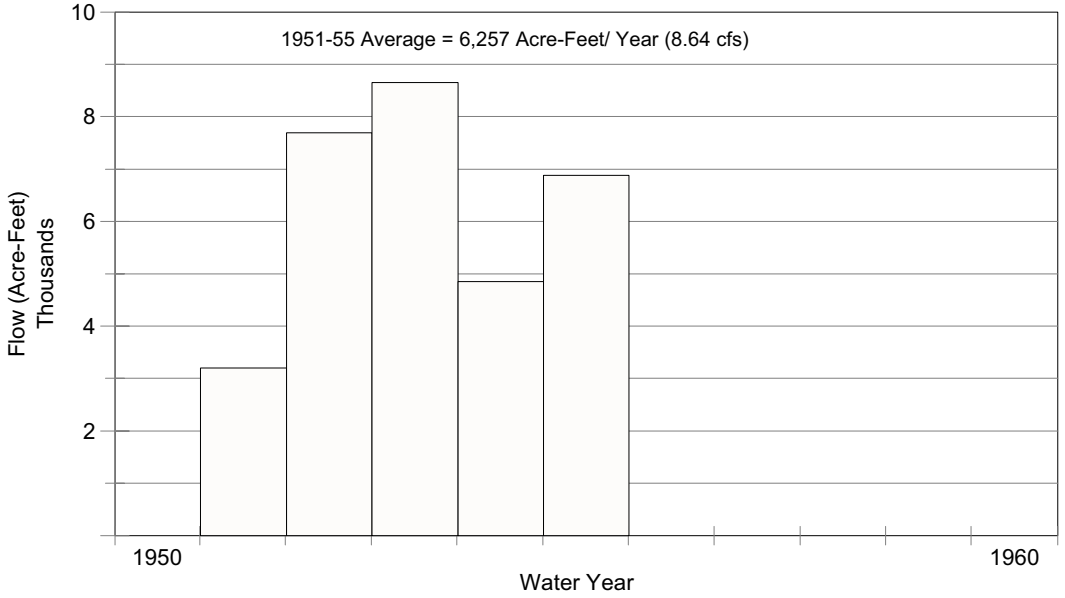


Table 5-3
Peak Flows
West Colorado River Basin

Station	HDM[a] CFS	HDM[a] Date	LDM[b] CFS	LDM[b] Date
Price River near Heiner	9,340	9/13/40	0.4	8/21/61
Price River at Woodside	11,200	9/7/91	0	1960,1961 1963,1992
Huntington Creek near Huntington	1,680	5/24/84	3	2/5/81
Cottonwood Creek near Orangeville	7,220	8/1/64	1.2	4/8/66
Ferron Creek (Upper) near Ferron	4,180	8/27/52	0	10/19-21/1976
San Rafael River near Green River	12,000	9/2/09	0	Many years
Seven Mile Creek near Fish Lake	424	6/12/95	1.3	10/30/94
Fremont River near Bicknell	1,200	4/5/42	18	6/15/12
Muddy Creek near Emery	3,340	5/10/52	0	4/13/11
Dirty Devil River near Hanksville	35,000	11/4/57	0	Many years
Pine Creek near Escalante	1,010	8/2/67	0	Many years
Escalante River near Escalante	3,450	8/1/53	0.07	7/11/90
East Fork Boulder Creek near Boulder	483	5/20/64	8.2	11/5/51
Paria River near Cannonville	11,600	8/31/63	0	Many years
Paria River at Lee's Ferry, Arizona	16,100	10/5/26	0	1928

[a]High daily maximum
[b]Low daily minimum

Source: U.S. Geological Survey

Figure 5-18

MONTHLY STREAMFLOW PROBABILITIES

Price River near Heiner (Helper)

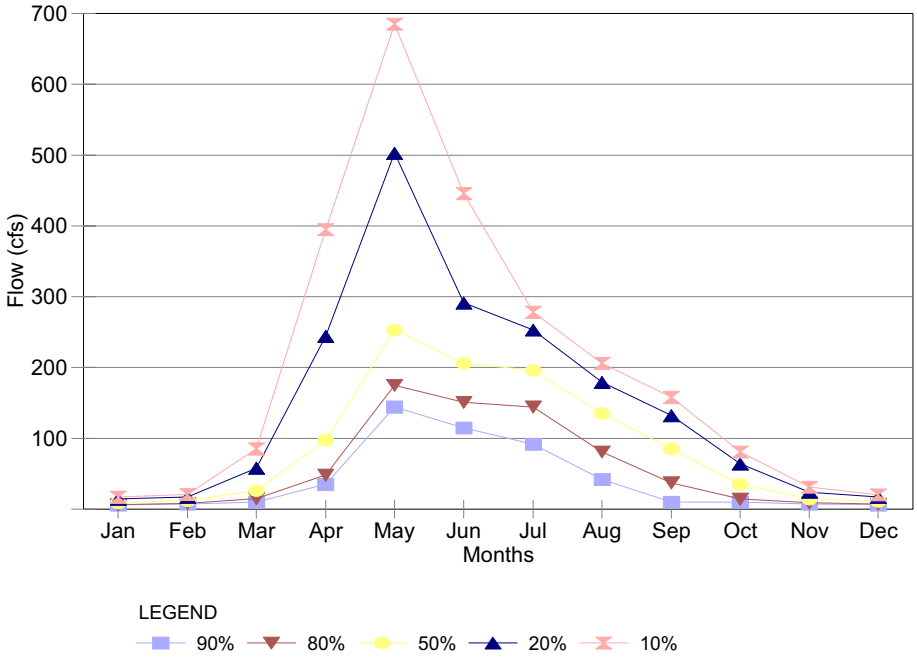


Figure 5-19

MONTHLY STREAMFLOW PROBABILITIES

Huntington Creek near Huntington

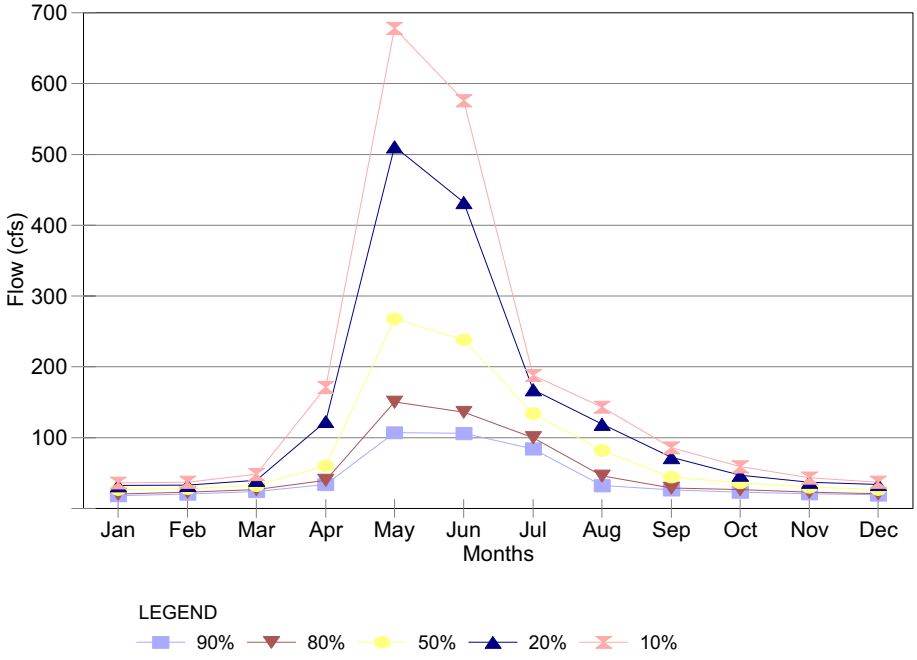


Figure 5-20
MONTHLY STREAMFLOW PROBABILITIES
Cottonwood Creek near Orangeville

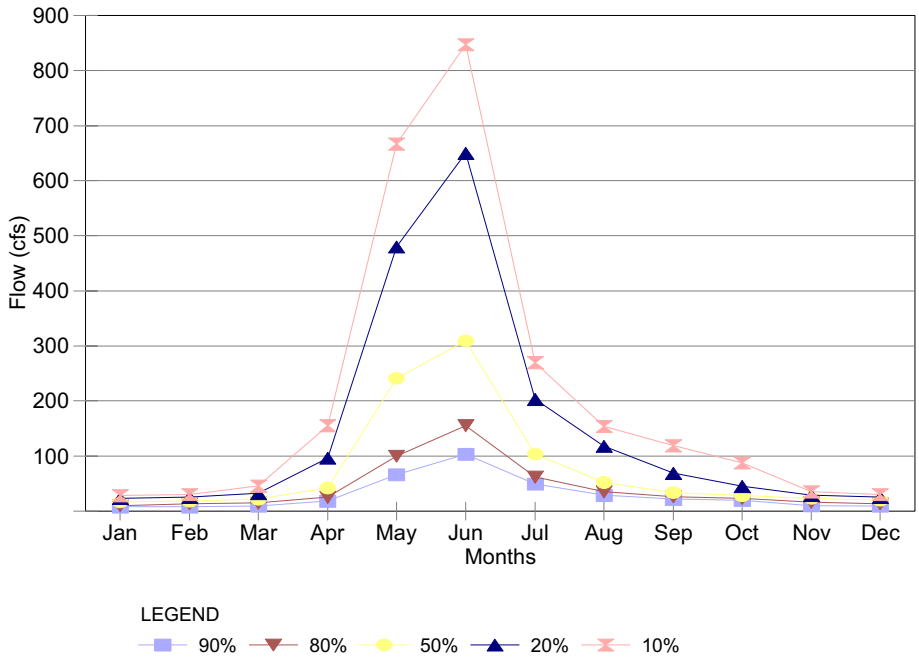


Figure 5-21
MONTHLY STREAMFLOW PROBABILITIES
Ferron Creek (Upper Station) nr Ferron

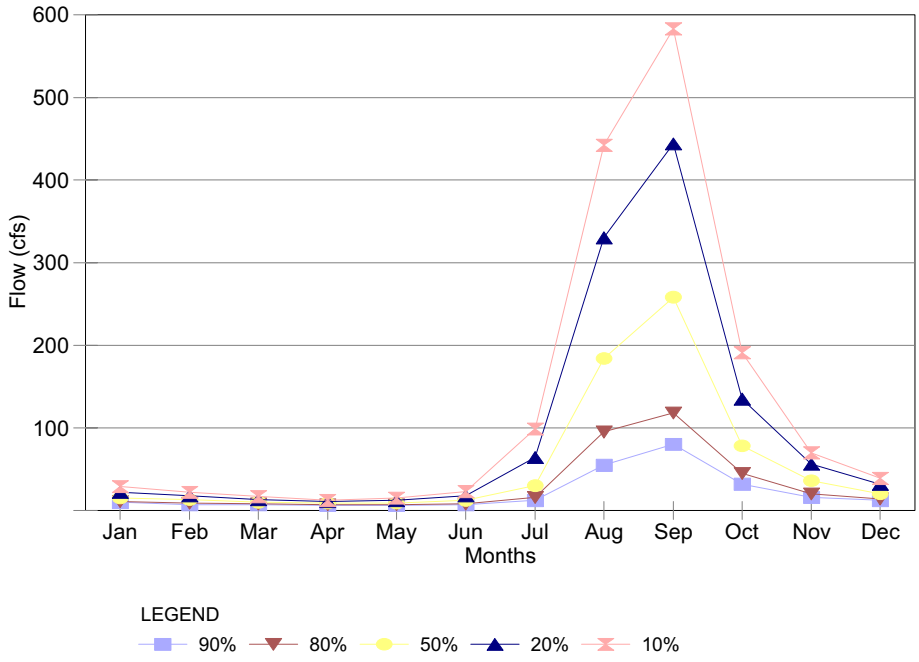


Figure 5-22
MONTHLY STREAMFLOW PROBABILITIES
Muddy Creek near Emery

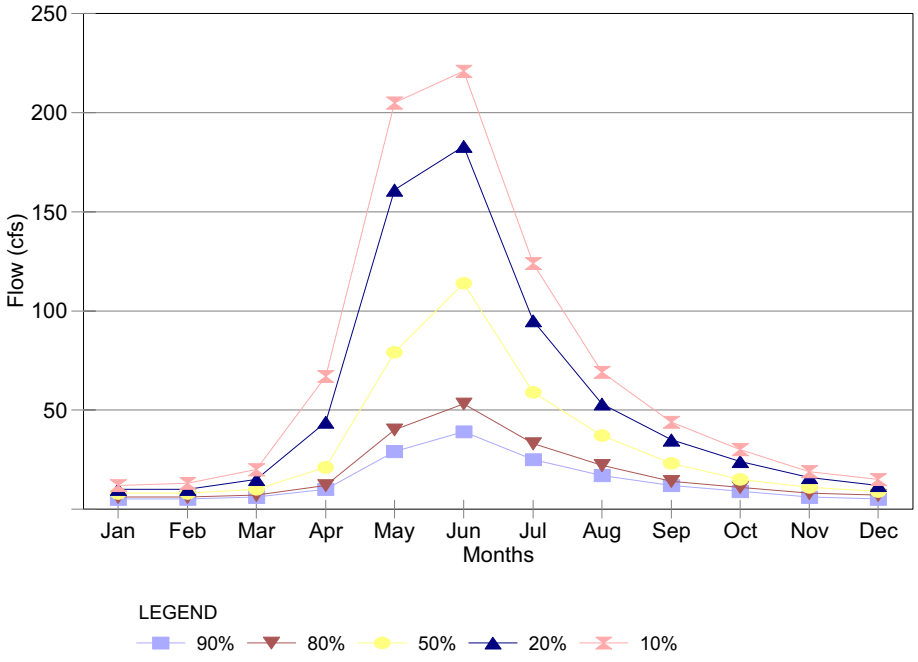


Figure 5-23
MONTHLY STREAMFLOW PROBABILITIES
Fremont River near Bicknell

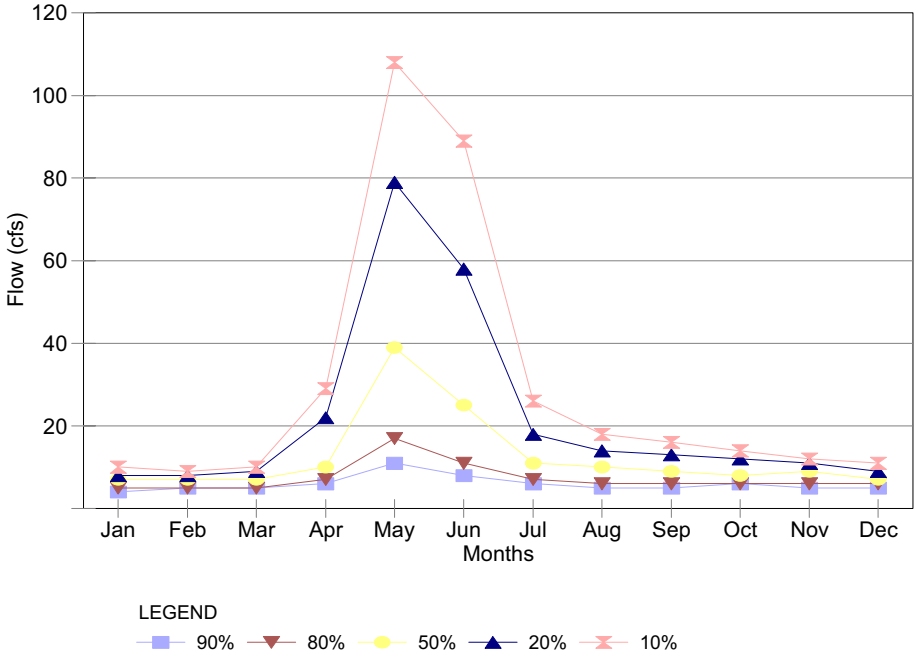


Figure 5-24
MONTHLY STREAMFLOW PROBABILITIES
Pine Creek near Escalante

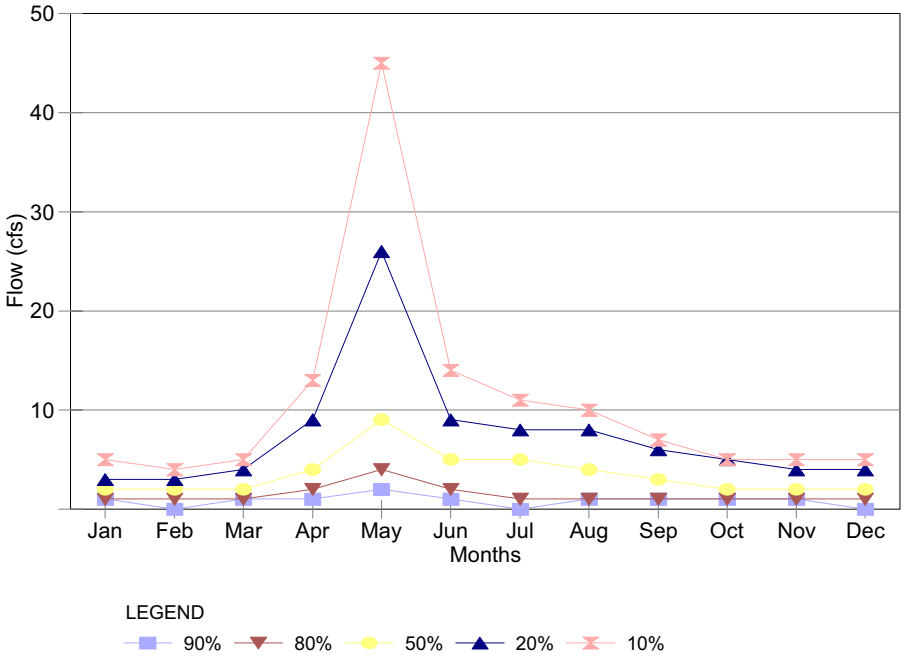


Figure 5-25
MONTHLY STREAMFLOW PROBABILITIES
Escalante River near Escalante

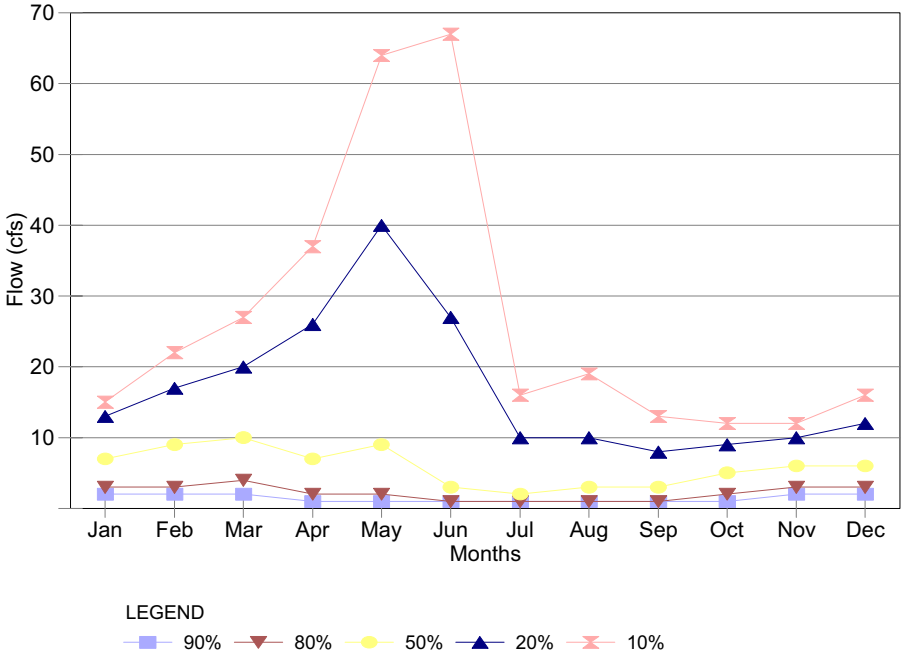


Figure 5-26
MONTHLY STREAMFLOW PROBABILITIES
East Fork Boulder Creek near Boulder

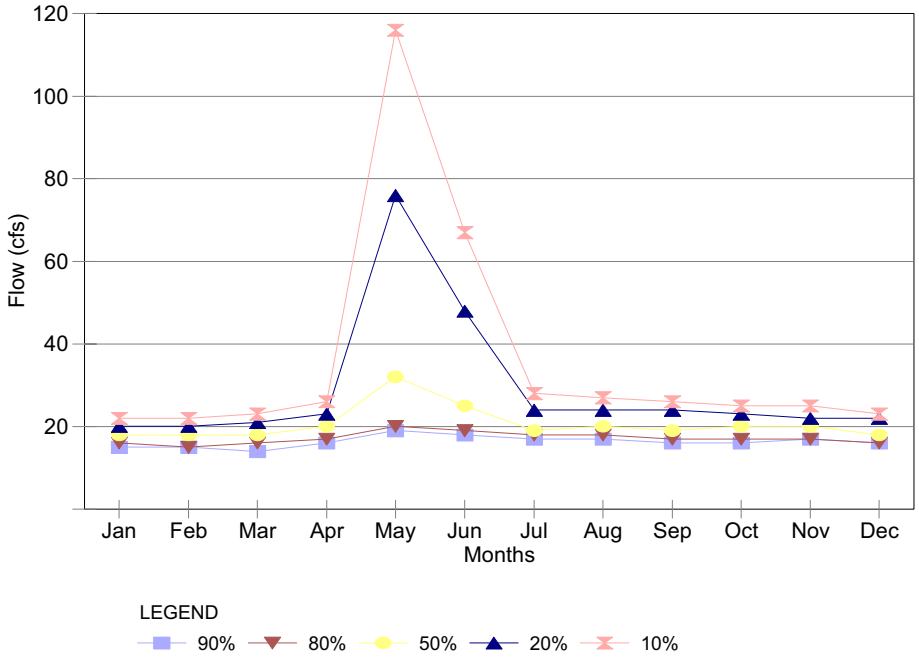


Figure 5-27
MONTHLY STREAMFLOW PROBABILITIES
Paria River near Cannonville

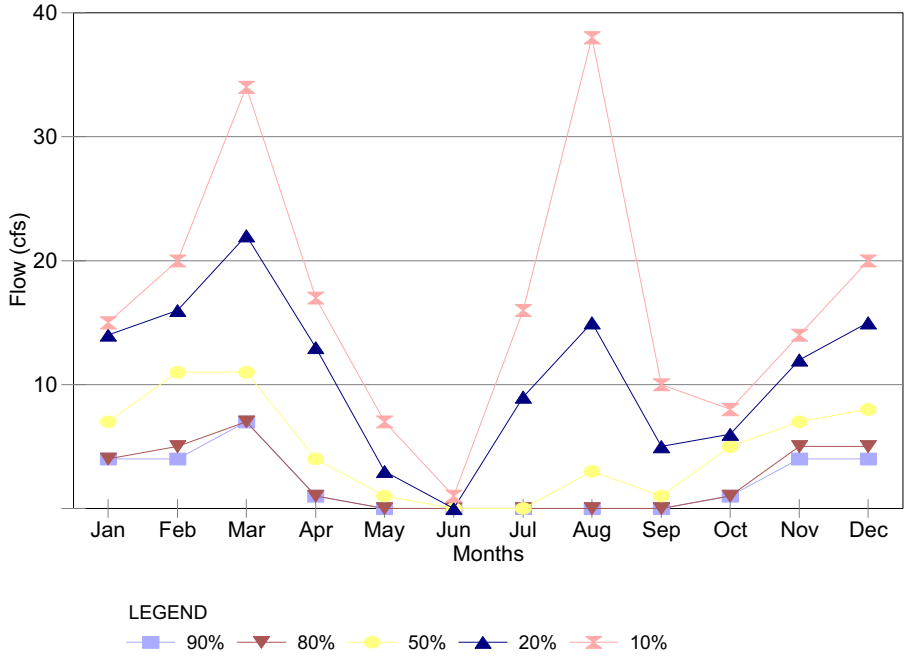


Table 5-4
Flood Frequency For Price River Near Heiner (Helper), Utah
1935-1969 and 1980-1981 and 1990-1991

RETURN PERIOD	PROBABILITY	VALUE (cfs)
2 YEARS	50	977
5 YEARS	20	1945
10 YEARS	10	2916
25 YEARS	4	4659
50 YEARS	2	6430
100 YEARS	1	8713
200 YEARS	0.5	11637
500 YEARS	0.2	16781

Table 5-5
Flood Frequency For Huntington Creek Near Huntington, Utah
1909-1979

RETURN PERIOD	PROBABILITY	VALUE (cfs)
2 YEARS	50	819
5 YEARS	20	1302
10 YEARS	10	1626
25 YEARS	4	2032
50 YEARS	2	2328
100 YEARS	1	2616
200 YEARS	0.5	2901
500 YEARS	0.2	3269

Table 5-6
Flood Frequency For Cottonwood Creek Near Orangeville, Utah
1910-1927 and 1932-1970 and 1976-1984

RETURN PERIOD	PROBABILITY	VALUE (cfs)
2 YEARS	50	1154
5 YEARS	20	1961
10 YEARS	10	2549
25 YEARS	4	3337
50 YEARS	2	3950
100 YEARS	1	4576
200 YEARS	0.5	5222
500 YEARS	0.2	6103

Table 5-7
Flood Frequency For Ferron Creek (Upper Station) Near Ferron
1912-1923 and 1948-1997

RETURN PERIOD	PROBABILITY	VALUE (cfs)
2 YEARS	50.0	840
5 YEARS	20.0	1383
10 YEARS	10.0	1794
25 YEARS	4.0	2369
50 YEARS	2.0	2835
100 YEARS	1.0	3330
200 YEARS	0.5	3862
500 YEARS	0.2	4618

Table 5-8
Flood Frequency For Fremont River Near Bicknell, Utah
1938-1943 and 1945-1958 and 1977-1996

RETURN PERIOD	PROBABILITY	VALUE (cfs)
2 YEARS	50	262
5 YEARS	20	474
10 YEARS	10	672
25 YEARS	4	1008
50 YEARS	2	1333
100 YEARS	1	1734
200 YEARS	0.5	2228
500 YEARS	0.2	3061

Table 5-9
Flood Frequency For Muddy Creek Near Emery, Utah
1909 and 1911-1914 and 1949-1996

RETURN PERIOD	PROBABILITY	VALUE (cfs)
2 YEARS	50	505
5 YEARS	20	1075
10 YEARS	10	1627
25 YEARS	4	2571
50 YEARS	2	3484
100 YEARS	1	4605
200 YEARS	0.5	5973
500 YEARS	0.2	8243

Table 5-10
Flood Frequency For Pince Creek Near Escalante, Utah
1951-1955 and 1958-1996

RETURN PERIOD	PROBABILITY	VALUE (cfs)
2 YEARS	50	165
5 YEARS	20	367
10 YEARS	10	544
25 YEARS	4	814
50 YEARS	2	1047
100 YEARS	1	1303
200 YEARS	0.5	1585
500 YEARS	0.2	1996

Table 5-11
Flood Frequency For Escalante River Near Escalante, Utah
1910-1912 and 1943-1955 and 1972-1996

RETURN PERIOD	PROBABILITY	VALUE (cfs)
2 YEARS	50	789
5 YEARS	20	1697
10 YEARS	10	2347
25 YEARS	4	3142
50 YEARS	2	3693
100 YEARS	1	4200
200 YEARS	0.5	4663
500 YEARS	0.2	5209

Table 5-12
Flood Frequency For East Fork Boulder Creek Near Boulder, Utah
1951-1955 and 1958-1972

RETURN PERIOD	PROBABILITY	VALUE (cfs)
2 YEARS	50	202
5 YEARS	20	304
10 YEARS	10	371
25 YEARS	4	454
50 YEARS	2	514
100 YEARS	1	572
200 YEARS	0.5	630
500 YEARS	0.2	704

Table 5-13
Flood Frequency For Paria River Near Cannonville, Utah
1951-1955 and 1959-1974

RETURN PERIOD	PROBABILITY	VALUE (cfs)
2 YEARS	50	2720
5 YEARS	20	4817
10 YEARS	10	6655
25 YEARS	4	9565
50 YEARS	2	12222
100 YEARS	1	15341
200 YEARS	0.5	19005
500 YEARS	0.2	24828

5.3.3 Lake Powell Water Budget [43]

The U. S. Bureau of Reclamation (USBR) operates Glen Canyon Dam and Lake Powell for water supply, electrical power generation, recreation, and fish and wildlife benefits. The USBR keeps records of reservoir releases, reservoir storage and evaporation, and bank storage estimates. Bank storage is the quantity of water stored in the rock surrounding the lake.

The Division of Water Resources recently conducted a water budget analysis for Lake Powell. The analysis used the USBR records for reservoir releases, reservoir storage and net evaporation. Inflow data were obtained from USGS records for Green River at Green River, USGS No. 09315000; Colorado River near Cisco, USGS No. 09185000; and San Juan River near Bluff, Utah Station No. 09379500. Tributary inflows from the San Rafael, Dirty Devil and Escalante rivers were obtained from water budget studies and represent the gaged flows of these tributaries into Lake Powell. Ungaged flow estimates were obtained from analysis of land use studies.

Figure 5-28 shows the Lake Powell (1976-1995) water budget analysis. The average annual releases from Lake Powell were 10,713,100 acre-feet during the period analyzed. This is greater than the annual release of 8.23 million acre-feet called for in the long range operating criteria. The increase is primarily due to the above average inflows of the mid-1980s and 1995, and the criteria requirement for equalization with Lake Mead. Additionally, there were 541,300 acre-feet of reservoir evaporation, 122,000 acre-feet change in storage from year to year, and 70,900 acre-feet of bank storage during this time period.

The mainstream storage reservoir evaporation is accounted to the states based on compact apportionment. Utah's long-term share of Upper Colorado River Compact mainstream reservoir evaporation annually is 120,000 acre-feet. Lake Powell's water supply is used to guarantee the

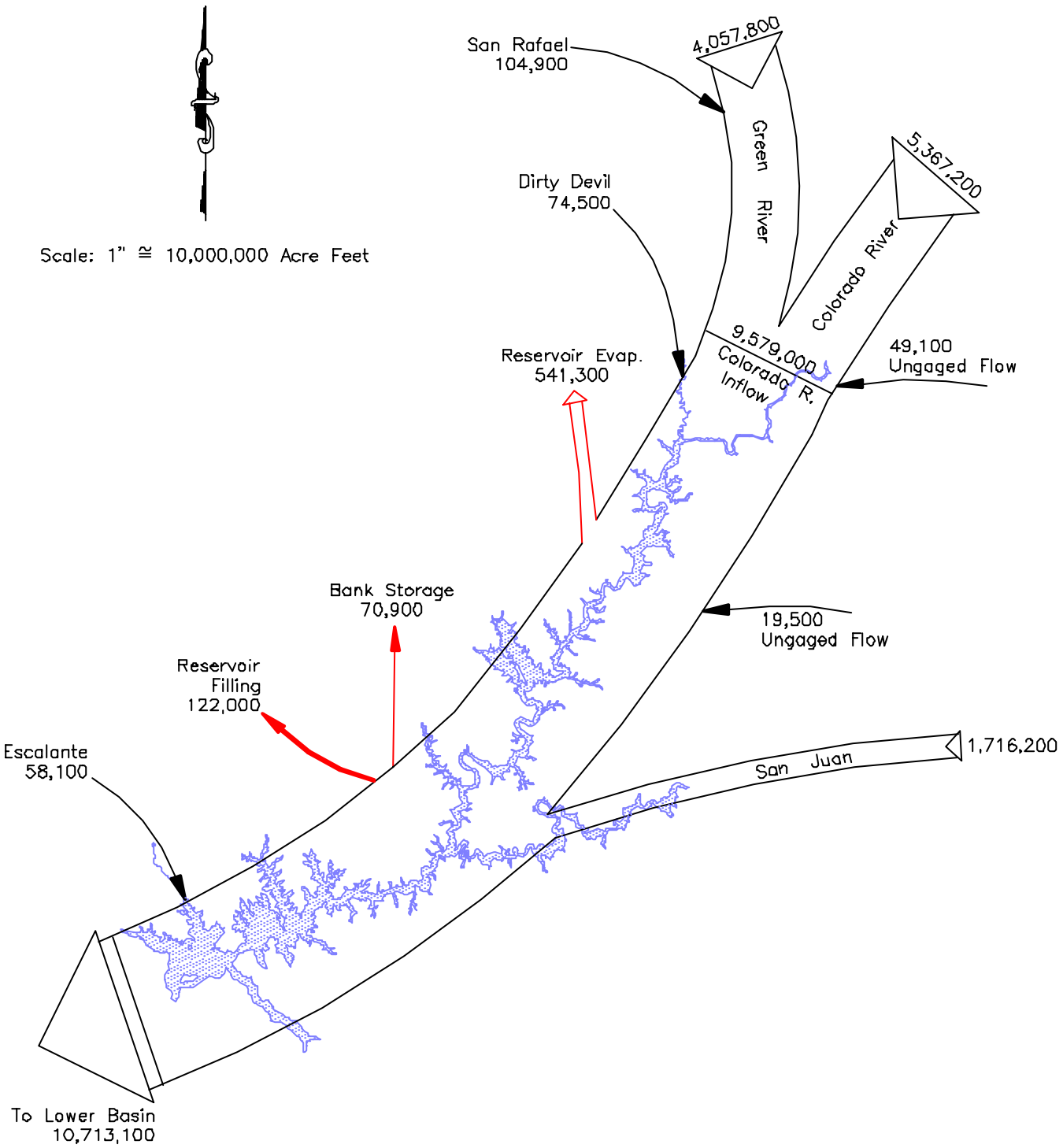


Figure 5-28
LAKE POWELL WATER BUDGET
1976-1995
West Colorado River Basin

Lower Colorado River Users the annual compact amount of 7.5 million acre-feet, while allowing the Upper Basin states to develop their allocated amounts. Based on present hydrology and apportionment by the compact, it is estimated that Utah's allowable depletion is about 1,369,000 acre-feet of Colorado River water.

5.3.4 Grand Staircase-Escalante National Monument Supply

The Division of Water Resources has recently completed a preliminary water supply study for the new Grand Staircase-Escalante National Monument (GSENM). Six streams with USGS stream flow gages were analyzed. Table 5-14 shows the data obtained for these stations. The data show that for most of the streams within the GSENM, summer thunderstorms produce nearly as much runoff volume as the spring snowmelt.

The BLM, USGS and the Division of Water Resources are cooperating to help gather more water base data. This informal arrangement hopes to gage more of the streams flowing into and through the monument. This base data will help in other future scientific studies conducted within the monument as well as to gain an understanding of the monument's water resources.

5.4 Water Use

Water is consumptively used for municipal and industrial (M&I) purposes, agricultural and livestock purposes, and wetland and riparian areas. Water is also non-consumptively used for instream flows and hydropower generation. Diversion and use of water requires a water right (see Section 7). Table 5-15 is a summary of water supplies that could be developed and consumptive uses in the West Colorado River Basin.

5.4.1 Agricultural Water Use

Water for irrigation of croplands is diverted from most rivers and streams flowing into the valley areas. About 95 percent of the water diverted for irrigation is surface water and five percent is groundwater from springs and wells. Surface water is diverted from streamflows and from surface storage reservoirs. Groundwater comes from wells drilled mostly in the Rabbit Valley area (Upper Fremont River drainage). Some wells are used only to supply supplemental irrigation water during the drier years or for late season shortages.

Surface water storage reservoirs make it possible to store water during periods of high runoff so it can be used during periods of low streamflows. This also makes irrigation feasible on the higher areas of the valley floors where groundwater is generally not available or too costly to pump. The existing surface water storage reservoirs are shown in Section 6, Table 6-1 and on Figure 6-1. Many of the reservoirs are also used for flood control and recreational purposes.

The irrigated lands are located within the six drainage basins in seven major areas. The Price drainage includes lands in and around Price City and the Cleveland/Elmo area. The San Rafael drainage includes lands located in and around communities of western Emery County (Huntington, Cleveland and Ferron). The Dirty Devil drainage includes two sub-drainages, Muddy Creek and the Fremont River. The irrigated lands along Muddy Creek are located in southwestern Emery County (Emery and Moore). The Fremont River lands are located in Wayne County in and around the communities of Fremont, Loa, Lyman, Bicknell, Cainville and Hanksville. The Escalante drainage lands are located in and around the communities of Boulder and Escalante in eastern Garfield County. The Paria drainage lands are mostly located in and around the communities of Tropic, Henrieville and Cannonville in southern Garfield County. The Lower Green drainage lands are located around Green River in eastern Emery County and western Grand County. The areas of irrigated land, water diversions and depletions are shown in Table 5-16.

5.4.2 Municipal and Industrial Culinary Water Use

Municipal and industrial (M&I) culinary water is used in homes, businesses, industry and public institutions. It also includes culinary water

Table 5-14
USGS Streamflow Gaging Stations in Grand Staircase-Escalante National Monument
West Colorado River Basin

Station	Elev. (feet)	Drain Area sq.mi.	Station Name	Period of Record	Mean Monthly and Annual Discharge (acre-feet)													
					Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	
9337000	6400	68	Pine Creek near Escaalante, UT	1955 1957-1997	194	178	140	135	124	166	403	1,044	426	345	304	224	3,593	
9337500	5760	320	Escalante R near Escalante, UT	1912-1912 1943-1955/1972-Present	499	411	462	510	596	800	888	1,455	1,133	433	557	414	8,260	
9338000	9315	21	E Fork Boulder Cr.Near Boulder	1949-1955 1957-1972	1,261	1,204	1,162	1,146	1,035	1,136	1,232	3,079	2,142	1,290	1,301	1,226	17,192	
9381000	6100	29	Henrieville Cr Nr Henrieville, UT	1950-1955	244	267	265	248	338	423	389	284	197	315	346	311	3,751	
9381500	5440	220	Paria River near Cannonville, UT	1951-1955	374	480	600	509	640	1,007	434	137	53	693	1,299	321	7,021	
9403600	5060	198	Kanab Creek near Kanab, UT	1979-Present	669	649	740	835	1,028	1,672	1,614	642	429	433	527	659	9,611	

Table 5-15
Current Water Supply Uses

Type/Category		Diversion (acre-feet)	Depletion (acre-feet)
Surface Water:			
Agriculture		285,050	156,200
Municipal & Industrial:			
Public Systems' Culinary		6,730	3,800
Public Systems' Secondary		8,367	4,200
Self-Supplied Industries		32,200	30,800
	SUBTOTAL	332,347	195,000
Groundwater:			
Agriculture		10,000	5,500
Municipal & Industrial:			
Public Systems' Culinary		4,186	2,400
Self-Supplied Industries' Culinary		3,685	2,200
	SUBTOTAL	17,871	10,100
TOTALS		350,218	205,100

Table 5-16
Current Irrigation Water Use

Drainage Basin	Area (acres)	Diversions (acre-feet)	Depletions (acre-feet)
Price	25,100	84,450	43,000
San Rafael	29,000	81,700	52,700
Dirty Devil	27,700	83,400	43,600
Escalante	4,400	23,100	12,400
Paria	2,700	7,750	3,500
Lower Green	3,000	14,650	6,500
Total	91,900	295,050	161,700

used to irrigate lawns and gardens and for other outside uses. Generally, population determines the demand for M&I water.

About one-half of the culinary water usage comes from groundwater, two-thirds from springs and one-third from wells. In most cases, these are treated by chlorination to bring them up to standard. Refer to Section 11, Drinking Water, for more information.

The divisions of Water Rights, Water Resources and Drinking Water collect data under the Utah Water Use Program in cooperation with the USGS. Data are collected from public water suppliers and industries using self-supplied water. The Division of Water Resources conducted a detailed M&I study in 1996. The diversions and depletions for current culinary water use are summarized by county in Table 5-17. Depletions are calculated as a percentage of the water diverted which does not return to the river or stream system. Most cities in the basin have sewage lagoons, which result in higher depletion values than other areas of the state.

Table 5-17
Current Culinary Water Use

County	Diversions (acre-feet)	Depletions (acre-feet)
Utah	1	0
Carbon	9,048	5,100
Sanpete	2	0
Emery*	3,582	2,500
Wayne	872	210
Sevier	22	20
Garfield	633	350
Kane	441	220
Total	14,601	8,400

*Includes some use in the Grand County side of Green River.

Also, industries using culinary water deplete nearly all of their demand. There is one hydroelectric power plant and four coal-fire plants in the basin. See Section 18 for more information

5.4.3 Municipal and Industrial Secondary Water Use

Water from secondary (dual) systems is used to irrigate lawns and gardens, parks, cemeteries and golf courses. These systems use untreated water and may be owned and operated by municipalities, irrigation companies, special service districts or other entities. Nearly every community in the basin has some users of secondary water within their boundaries. Castle Valley Special Service District operates its own secondary system for the communities in western Emery County.

The Huntington and Hunter power plants in Emery County and the Carbon and Sunnyside Co. generation power plants in Carbon County use large quantities of untreated water for coal-fired electrical power generation. Nearly all of this water is depleted. Current diversions and depletions for secondary water use are summarized in Table 5-18.

Table 5-18
Current Secondary Water Use[1]

County	Diversions (acre-feet)	Depletions (acre-feet)
Carbon	3,121[2]	2,700
Emery	35,601[3]	31,400
Wayne	1,141	570
Garfield	704	350
Totals	40,567	35,000

[1]Includes residential, institutional and industrial secondary water. Includes some pastures served within the Castle Valley Special Service District in Emery County.
[2]Includes power plants use of 2,000 acre-feet.
[3]Includes power plants use of 30,000 acre-feet.

5.4.4 Wetland and Riparian Water Use

Wetland and riparian areas include land and vegetation adjacent to rivers, streams, springs, bogs, wet meadows, lakes and ponds. These areas account for about 1 percent of the total land area. Wetlands and riparian areas are important habitat for migrating waterfowl and raptors during the winter months. They are also important for year-long wildlife residents. The Desert Lake and Bicknell Bottoms Waterfowl Management areas are very important for waterfowl in the Pacific Flyway. Other areas used for nesting and resting include the Colorado and Green river corridors.

5.5 Interbasin Diversions

The interbasin diversion from the East Fork of the Sevier River in the Sevier River Basin into the Tropic area (Paria River) is the only major import in the entire Colorado River Basin. This diversion has historically averaged about 4,800 acre-feet annually. The New Escalante Irrigation Company in Garfield County has a water right diligence claim on an import from Iron Spring Draw above Otter Creek Reservoir in the Sevier River Basin. An earthen ditch collects a small amount of the spring runoff and transports it into the Escalante River drainage. This right is currently being challenged by irrigators in the Sevier River Basin.

Tropic Canal

Exports out of the West Colorado River Basin are numerous. A small export is made from Fish Creek; tributary of the Price River system, to the Indianola Irrigation Company on Thistle Creek in the Utah Lake Drainage System. The Fairview (Narrows) Tunnel diverts water out of upper reaches of the Price River system to Fairview in the Sevier River Basin. There are 12 transbasin diversions from the Upper San Rafael drainage to the Sevier River drainage. Table 5-19 shows the amounts, and Figure 5-29 shows the locations for all of the West Colorado River Basin exports.

Existing evidence shows some groundwater movement out of Upper Fremont River to Antimony Creek in the Sevier River Basin. Springs in the upper reaches of Antimony Creek yield 10,000 acre-feet per year, which appear to be too high to come from within their own drainage.

5.6 Water Budgets

Eight hydrologic study areas are part of the West Colorado River Basin (see Figure 5-1). These study areas are used for preparing water-related land use inventories, water budget reports, and municipal and industrial water supply and use reports. The water budget is an accounting of the water supplies, uses and outflows for a given subarea. Table 5-20 shows a summary of the water budget analysis for the eight hydrologic study areas of the West Colorado River Basin. The water budget base period is 1961-1990, although in some cases a different period is based on the available data. Because of the different base periods used, the outflows for each drainage are slightly different than the flow diagrams shown in Figures 5-2 through 5-6. Figure 5-30 contains pie charts showing the supply and use in the basin among various categories.

5.7 Water Supply and Use Problems

Like many areas of the state and throughout the western U. S., the San Rafael River drainage appears to have had a decrease in its water yield over the past 80 years. While there could be many reasons for this, such as climate change or improved watershed conditions, one apparent prevailing theory is the decline of aspen in the western United

Table 5-19
West Colorado River Basin Transbasin Diversions

Number	Diversion	Average (1941-1990) (ac-ft/yr.)
	EXPORTS	
	Price River to Utah Lake Basin	
1	Lucy Fork (Indianola) Ditch (Estimated)	100
	Subtotal	100
	Price River to Sevier River Basin	
2	Fairview (Narrows) Tunnel (Gaged)	2,470
	Subtotal	2,470
	San Rafael to Sevier River Basin	
3	Candland Ditch (Estimated)	200
4	Coal Fork Ditch (Estimated)	260
5	Twin Creek Tunnel (Estimated)	200
6	Cedar Creek Tunnel (Estimated)	340
7	Black Canyon Ditch (Estimated)	290
8	Spring City Tunnel (Gaged)	1,900
9	Reeder Ditch (Estimated)	250
10	Horseshoe Tunnel (Estimated)	600
11	Larsen Tunnel (Estimated)	690
12	Ephraim Tunnel (Gaged)	1,900
13	Madsen Ditch (Estimated)	40
14	John August Ditch (Estimated)	200
	Subtotal	6,870
	Total Exports	9,440
	IMPORTS	
	Sevier River to Paria River	
1	Tropic Canal	4,800
2	Iron Spring Draw	N/A
	NET EXPORTS	4,600

Source: U.S. Geological Survey and Upper Colorado River Commission

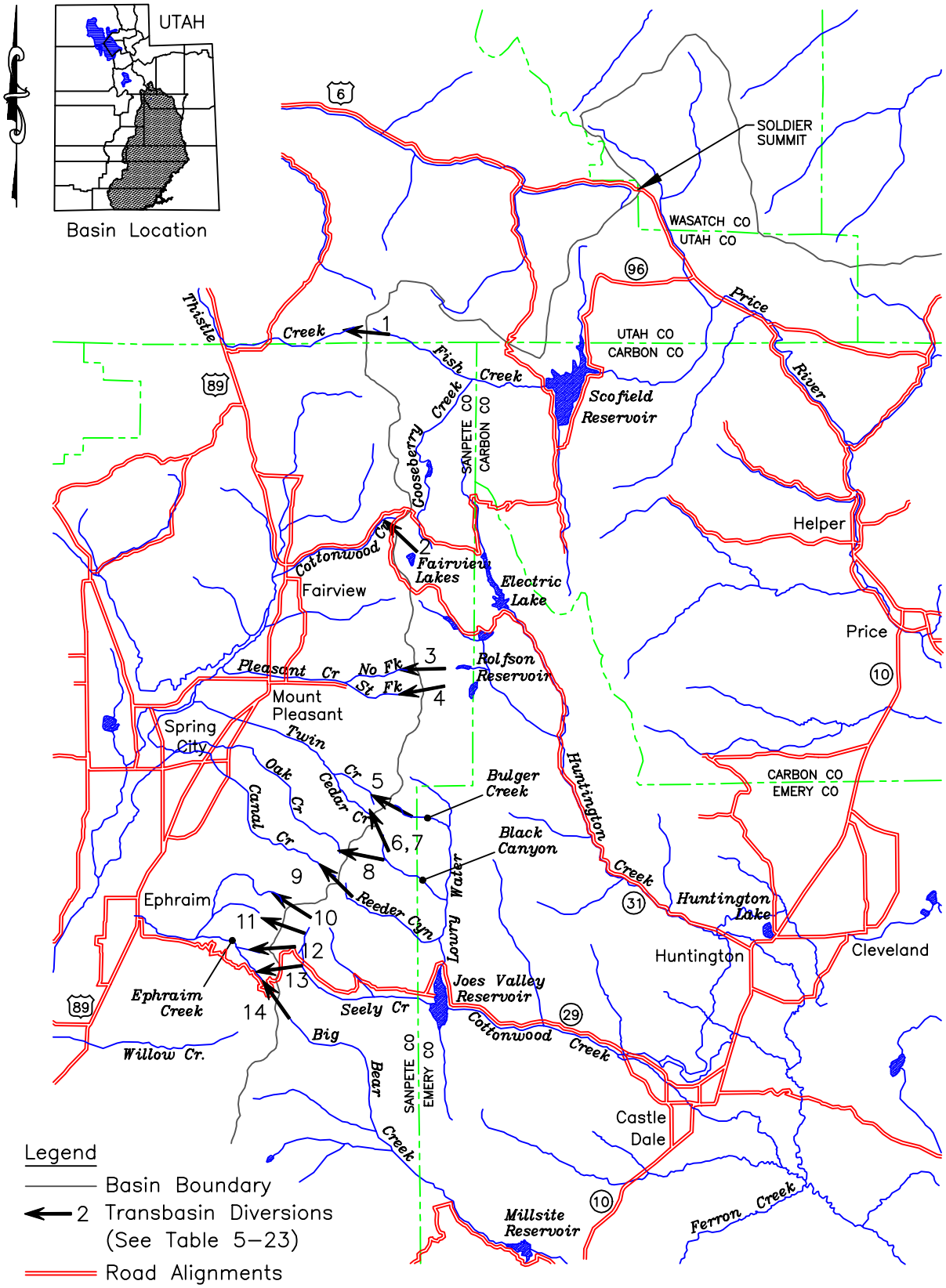


Figure 5–29
TRANSBASIN DIVERSIONS – EXPORTS
West Colorado River Basin

Table 5-20
Summary Water Budget Analysis (1961-1990)
West Colorado River Basin
(acre-feet/yr.)

Drainage	Yield	Agricultural Depletion	Municipal & Industrial Depletion	Wet/Open Water Depletion	Exports	Imports	Outflow
Price River	138,000	43,000	8,800	17,000	2,600	29,000	95,600
San Rafael	233,000	52,700	32,400	23,000	35,900	4,000	93,000
Dirty Devil	147,000	43,600	1,000	18,000	4,000	0	80,400
Escalante	86,000	12,400	400	12,000	0	0	61,200
Paria	21,000	3,500	300	2,000	0	4,800	20,000
Lower Green	5,000	6,500	500	6,000	0	8,000	0
Total	630,000	161,700	43,400	78,000	42,500	45,800	350,200

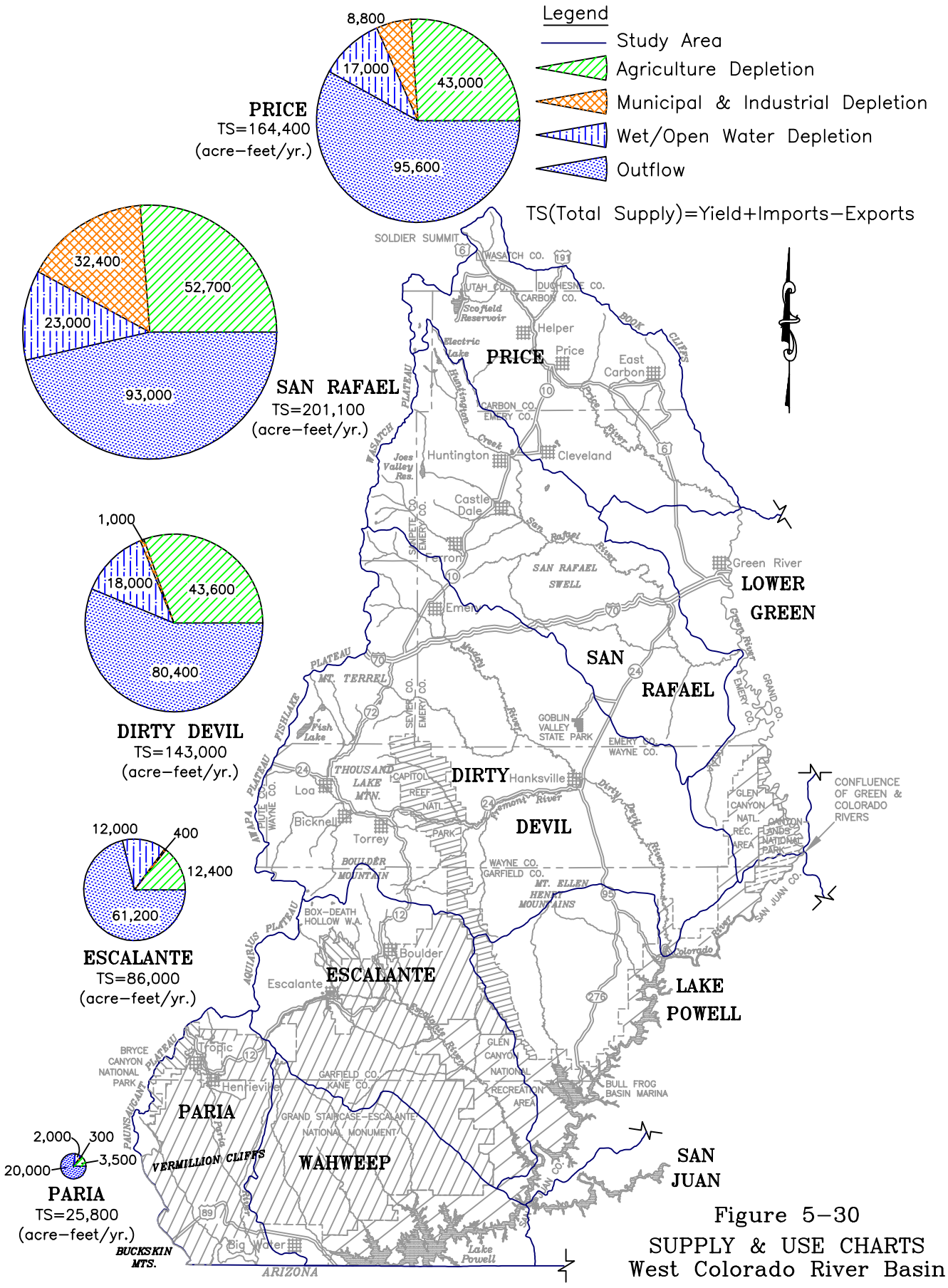


Figure 5−30
SUPPLY & USE CHARTS
West Colorado River Basin

States. The mountainous areas of this drainage have experienced a loss of about 100,000 acres of aspen-dominated landscapes to mixed conifer landscapes. Mixed conifer landscapes consume about 250-500 acre-feet per 1,000 acres more than aspen landscapes. This would result in about 35,000 acre-feet loss of the water supply through additional transpiration. Much more research needs to be conducted to verify this theory.

5.8 Water Quality

Streams in the West Colorado River Basin originate in areas that are considerably different from each other in aspect, geology, land use, vegetation and altitude. These affect the quality of water flowing from a given area.

The quality of the groundwater reservoirs is impacted by the recharge water. This water comes from surface tributary inflow recharging the groundwater as it flows over alluvial fans and from groundwater tributary inflow. Groundwater is also supplied by losses from surface streams, canals and deep percolation from irrigation of croplands.

The quality of surface water and groundwater supplies varies throughout the basin. This affects the use and management of these water resources. Stream and river flows are generally of good quality in the upper reaches, but deteriorate as they flow downstream. Water quality in the upper reaches of all the major drainages is good with total dissolved-solids of around 200 mg/L. This increased substantially to about 3,600 mg/L at the mouth of the Price River, 1,600 mg/L at the mouth of the San Rafael River, 2,000 mg/L at the mouth of the Dirty Devil, 900 mg/L at the mouth of the Escalante River and 1,700 mg/L at the mouth of the Paria River. Refer to Sections 12 and 19 for data on the water quality.

5.9 Issues and Recommendations

The only issue discussed is over-appropriation of existing water supplies.

5.9.1 Over-Appropriation of Existing Water Supplies

Issue - The Price and San Rafael drainages are over-appropriated.

Discussion - The West Colorado River Basin, like many other areas of the state, has a problem in overall supply and uses with regards to water rights. Much of the basin is over-appropriated and, as a result, late season shortages exist in many of the agricultural areas. Table 5-21 shows the perfected water rights versus the yields of the major drainages within the basin. The San Rafael River is the most over-appropriated drainage in the basin. As a result, river commissioners have been appointed in Cottonwood and Huntington creeks to administer the rights properly, especially in dry years. The Price River also has a river commissioner.

Recommendation - The state engineer should study this situation and adjudicate the Price and San Rafael drainages. ●

Table 5-21
Water Rights Versus Yield

Drainage	Yield (acre-feet)	Use	Perfected Water Rights (Depletion)[1] (acre-feet)
Price	138,000	Irrigation	80,566
		M&I	64,147
		Subtotal	144,713
San Rafael	233,000	Irrigation	267,003
		M&I	41,128
		Subtotal	308,131
Dirty Devil	147,000	Irrigation	57,059
		M&I	27,864
		Subtotal	84,923
Escalante	86,000	Irrigation	14,616
		M&I	4,207
		Subtotal	18,823
Paria	21,000	Irrigation	6,644
		M&I	5,966
		Subtotal	12,610

[1]Includes some water rights based on high flows that only occasionally occur.